AUGUST 1952

# ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING



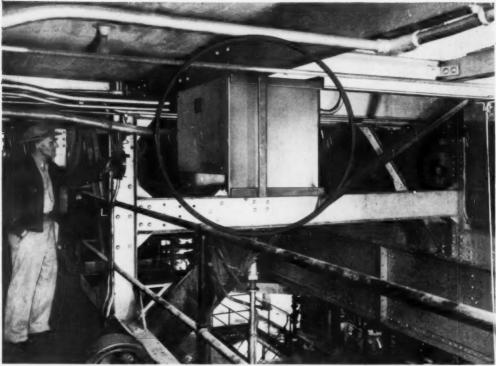
MODERN WIRING and lighting complement
advanced architectural design in a California department store



FULL LOAD standby diesel generators protect florida hospital electrical needs.



LOUVER CEILING modernizes lighting in New Jersey banking institution.



60-kvar capaciter unit shown above is part of the 600-kvar installation that permitted a 10% increase in load.

Capacitors can be put in out-of-the-way places—such as

## Seriously overloaded circuits take on 10% more load after G-E Capacitors are added

American Crystal Sugar Co. profits from an emergency that arose during a recent sugar refining "campaign."

During a sugar beet "campaign" which lasts from July to December, the American Crystal Sugar Company of Clarksburg, California, operates 24 hours a day. Shutdowns mean costly financial losses.

That's why the company really had an emergency on its hands when its electrical facilities became seriously overloaded in a recent campaign. However, the solution was simple. A call to G.E. brought 600 kyar of capacitors to the plant in time to prevent a "burnout."
A short time after the order was placed, the capacitors were installed and in operation. The plant's power factor climbed from 86% to about 97%. This relieved the overloading—and released enough capacity to handle a subsequent 10% increase in load!

CAPACITORS HAVE MANY USES

They can often free distribution facilities to carry 20 to 30% more load.

Where voltage drop is a problem, capacitors can provide the needed voltage boost inexpensively. And if your power factor is below 85%, and you have a power-factor or kvademand clause in your contract, they can usually cut your power costs.

For more information, see your local G-E Apparatus sales office, or authorized G-E agent or distributor. Or write to Section 407-209 for booklet GEA-5632—"How to Reduce Power Costs and Gain System Capacity." General Electric Company, Schenectady 5, New York.

GENERAL ( ELECTRIC

#### LEVITTOWN, PA.

Handles the Load

Murray

#### MATCHED EQUIPMENT

Levittown, Pa., a new city of 16,000 homes, is rising in the eastern part of Pennsylvania. Each house is fully equipped with the most modern electrical conveniences. To handle the load, two Murray companion units were installed — the Murray Meter Socket and the Murray "Main and Range."

When Levitt and Sons, the nation's largest builder, specifies equipment, you can be sure that it is high quality and easy to install.

#### Murray Can Supply Both Meter Mounting And Service Entrance Equipment.

For a few homes — or thousands — Murray tracked equipment will make your job easier. Matched equipment is easier to wire and easier to install because the units are designed to fit regarber — looks neater, too. On your next job — whether it's a bungalow or a huge development, ask your jobber for Murray matched equipment.



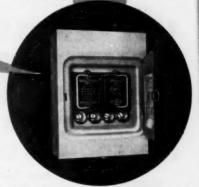
Electricians like Murray equipment because it is easy to install. There's always plenty of wiring room, in Murray equipment!



Outdoor Meter Social. Supplied with four jaws which are reversible for vertical or heritantal mounting. Hubs are locked in permanently. Social and hubs made of corresion resistant steel. Suched in gray, baked-on Melamine.



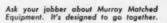
One out of 16,000 houses being built at Levittown, Pennsylvania. Murray Maler tocket is located on auticle wall, rear. Murray "Male and Bases" located in a utility room, backs it up on the Incide.



Main and Range with four branch lighting circuits. Two pullout type switches — fusible. Solderless pressure connectors. Baked-on gray Melamine finish.



Murray Meter Socket and Main and Range back up to each other. This saves on wire and makes the wiring job easier. Permits more adequate wiring all around.

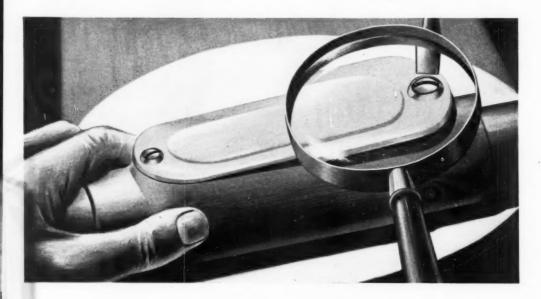




#### MURRAY MANUFACTURING CORPORATION 1250 Atlantic Avenue, Brooklyn 16, New York

Service Entrance & Meter Equipment \* Magnetic Hydraulic Circuit Breakers \* Safety Switches (Types A, C & D) \* Current Limiting Reactors \* Crows'nest Aerial Ladders

### No lost screws, No scuffed fingers, No lost time!



## LOKT-SCREW

COVERS

#### **FOR FORM 35 UNILETS**



New "Ball-and-Socket"

End view of time-saving "Lokt-Screw" cover shows rocking action of "Ball-and-sockel" type screws, permitting one side of cover to be completely tightened before tightening of second screw begins. Screws are held permanently in place by steel of the cover itself!

Action Screws!



Sold Through Electrical Wholesalers

#### APPLETON ELECTRIC COMPANY

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MILWAUKEE

Export Representatives: International Standard Electric Corp., 67 Broad St., New York 4, N. Y.

New Appleton LOKT-SCREW covers offer time and trouble saving advantages you find in no other conduit fitting cover—and you get them at no extra cost!

Precision-threaded, easy-turning screws on Appleton LOKT-SCREW covers are held permanently in place by steel collars which completely surround screws, a feature which also prevents finger-bruising screw-driver slippage.

The Appleton LOKT. SCREW cover is only one of hundreds of Appleton wiring devices expressly designed to bring greater speed and convenience to every job. For highest quality fittings to meet every wiring requirement, specify Appleton—The Standard for Better Wiring.



with which is consolidated Electrical Contracting. The Electragist and Electrical Record . . . Established 1981

Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

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Published monthly by Mediraw-Hill Publishing Company, Inc., James H. Mediraw (1860-1948), Founder, Fuldication office, 29-128 North Read-Founder, Fuldication of Sec., 29-128 North Read-Founder, Fuldication of Sec., 29-128 North Read-Founder, Fuldication of Sec., 29-128 North Read-Founder, 29-128 N. Beary, Albany I. N. Y., or 330 W. 42nd St., New York, So., N. Y. Allow one menth for change of address, correspondence to Electronic Medication of Medication of Sec., 29-128 N. Beary, Albany I. N. Y., or 330 W. 42nd St., New York, So., N. Y. Allow one menth for change of address, or section of the Company of the Sec., 29-128 N. Beary, Albany I. N. Y., or 330 W. 42nd St., New York, So., N. Y. Allow one menth for change of address, or section of the Company of the Sec., 20-128 N. Beary, Sec., 20-1	Modern Lighting  Effective industrial lighting uses R 52's in high bays; 100 footcandles for industrial machine shop; French use dual light in hospital wards.				
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For trouble-free installations For easier wiring For customer satisfaction

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- A real T-rated switch with \*torsionally pre-loaded contacts. (This means exceptional performance smooth action more, plenty more, makes and breaks per switch.)
- · Positive kick-off.
- \*Patented and patents applied for

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Meets Federal and REA Specifications

Rating-10 A., 125 V T; 5 A., 250 V.

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THE GREEN LABEL DISTINGUISHES NEW G.E 40-WATT RAPID-START BALLAST FROM OTHER G-E BALLASTS-NOTE SIMPLIFIED CIRCUIT

## **New G-E Lighting Development**

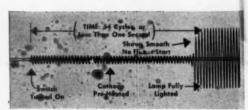
#### 40-watt RAPID-START system eliminates starters

General Electric—first to introduce fluorescent lighting in 1938—now brings you a starterless system giving full, rated lamp life. New, electrically matched 40-watt RAPID-START lamps and ballaste do away with bothersome blinking at end of lamp life, give you eye-easy, no-flicker starts at a touch of the switch!

Present "instant-start" 40-watt fluorescent is costly, uses a heavier ballast—present "switch-start" is complicated by auxiliary starters and wiring—new RAPID-START system features smaller, lighter ballasts at a lighting cost comparable to 40-watt switch-start lighting.

General Electric lamp and ballast engineers have again combined their efforts to bring you a revolutionary development in 40-watt fluorescent lighting—the volume market. For new installations or to modernize old installations—a sales plus your customers will want! Act today. Contact your nearest G-E Apparatus Sales Office, or write Section 412-102, for complete information. General Electric Co., Schenectady 5, N. Y.





ENGINEER'S ANALYSIS of oscillograph readings shows fast, noflicker pre-heated cathode action of new G-E Rapid-Start.



Greatly magnifice

NEW G-E BIPIN LAMP, especially developed for fast, pre-heat starting, employs complex, triple-coiled cathode, right.



Hard to believe that a tape only .007 inch thick can handle a job like this! Yet here's the proof right before your eyes—"Scotch" No. 33 Electrical Tape being applied to busses that carry up to 13,000 volts! And see the neat results—clean, compact and trim. No wonder Powerlite Switchboard Co., Cleveland, Ohio, reports complete satisfaction.

They're satisfied with more than the fine appearance, of course. "Scotch" No. 33 Electrical Tape is easier to apply, and it lasts longer, too. It resists weathering, abrasion, acids, oils, alkalies and water. A little goes a long way, since "Scotch" 33 has a dielectric strength of 10,000 volts.

Try it yourself and see! Your supplier has many widths and lengths—including the popular ¼ inch x 20 ft. "Job Size" rolls packed 12 to a screw-top container. Order today!



The term "Scotch" and the plaid design are registered trademarks for the more than 200 pressure-sensitive adhesive tapes made in U.S.A. by Minnesota Mining & Mig., Co., St. Paul 6, Minn.—also makers of "Scotch" Sound Recording Tape, "Underscal" Rubberized Coating, "Scotchilite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: 122 E. 42nd St., New York 17, N. Y. In Canada: London, Ont., Can.



Electrical Tape No. 33



### YOUR DRIVE DESIGN PROBLEMS

Allis-Chalmers Matched Motors, Control and V-Belt Drives Save Design Time and Cut Manufacturing Cost



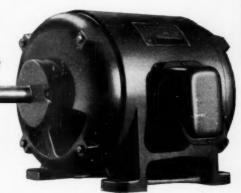
#### CONTROL

Complete matched control for any motor, including manual and magnetic starters, pushbuttons, and variable speed control.



#### Texrope V-BELT DRIVES Fixe

speed and Vari-Pitch sheaves with stationary or motion control. Famous grommet belt construction. Most complete line of V-belt drive equipment in the industry.



MOTORS Standard open drip-proof, splash-proof, totally-enclosed, fan-cooled and explosion-proof,  $\frac{1}{2}$  hp and up. Also wound rotor and direct current. Special motors to meet your requirements.

#### Get the Kind of Help You Need

Allis-Chalmers representatives in every industrial center are at your command. Just call the office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin for helpful literature.

Allis-Chalmers Motors and Control Texrope V-Belt Drives 51B6052 20B6051

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There's No Substitute for Highest Integrity of Materials and Workmanship as a Solid Business Builder!

Habirshaw wires and cables enjoy immediate acceptance, wherever they are specified—and for excellent reasons.

For over 65 years this brand has met the building industry's highest standards—has proved its quality and durability in thousands of buildings of every type.

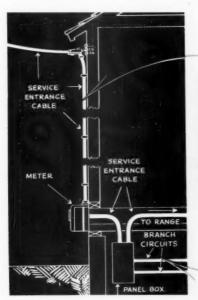
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## PHELPS DODGE COPPER PRODUCTS



## **MEANS WIRED FOR LIFE!**



 Diagram, left, shows how one Habirshaw cable meets requirements of both service entrance and drop, through meter to panel box. Also approved for direct run to electric range.



 Design of Habirshaw service entrance cable makes it highly flexible for easy handling, difficult bends.



• PD-X nonmetallic-sheathed cable for branch circuits is extra clean for fast working. Saves wiring time. Dry-Type
TRANSFORMERS

Convert Line Losses To Profits



REGULATED, LOW-LOSS POWER SERVICE is the key to top motor, lamp and machine efficiency. You can achieve efficiency at low cost with the Allis-Chalmers dry-type transformer.

Placed at the load center, it shortens long feeders and makes important savings in power and hard-to-get copper. It provides correct utilization voltages for lighting, machine tools, infra-red drying ovens and other equipment.

Smaller rated transformers mount on posts, platforms or on machines themselves. In most types Fiberglas (Class B) insulation provides safe, durable construction . . . with big savings in weight. No need to worry about liquid maintenance or bulky radiators, either.

Contact your nearby A.C district office for more facts or write Allis-Chalmers, Milwaukee 1, Wisconsin.



\* HERMETICALLY

SEALED dry-type transformers operate under all hazardous conditions. They're sealed in an inert atmosphere to eliminate internal maintenance. Ratings to 1500 kva, 3-phase, 15 kv.



\* COMPLETELY

ENCLOSED dry-type transformers operate well in dusty or lint-filled atmospheres. Small and light ... install on walls, posts or platforms. Ratings 25 kva and smaller, 600 volts and below.



#### \* GENERAL PURPOSE dry-

type transformers are used for small power and lighting services. Easy to hook up; need no special enclosures. Single-phase sizes 167 kva and smaller; three-phase sizes 300 kva and smaller. Ratings 600 volts and below.



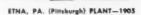


## PITTSBURGH STANDARD

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Proudly we build our ultra-modern new plant to supply you with

MORE QUALITY CONDUIT



More conduit, in the uncompromisingly perfect quality of Pittsburgh Standard, is on the way as we increase our productive capacity with our new plant facilities adjacent to the Fairless Works, Morrisville, Pa. The same guarantee of 100% perfect conduit... in all types... will now be enhanced with our newer, more modern equipment. And ... after 50 years of growth ... we've changed our company name, from Enameled Metals' Company, to its accepted "brand name"... PITTSBURGH STANDARD CONDUIT CO.

Now, more than ever . . . with even faster service to our huge nation-wide markets . . . PITTSBURGH STANDARD conduit will be "the standard of the trade."

Agents In All Principal Cities



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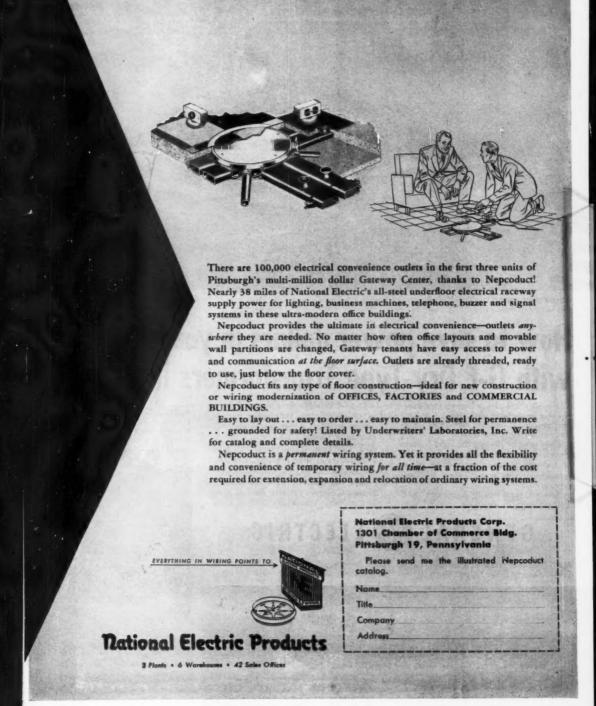
Electro-Galvanized
Black Enameled
Hot Dip Galvanized

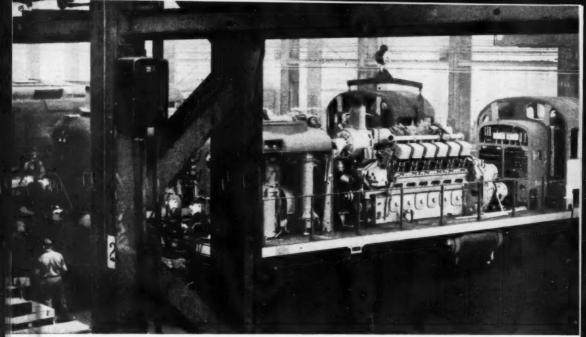
Elbows, Nipples, Couplings Briegel E.M.T. Fittings

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . AUGUST, 1952



# because Gateway Center has





COLUMN-MOUNTED Dry-Type Transformers at American Locomotive Company, Schenectady, N. Y., save floor areas for machines and

materials. These Type M's supply proper voltage for high-bay lighting at final assembly operation on diesel-electric locomotives.

## How to save power dollars in your industry with G-E Dry-Type Transformers like these

Throughout industry, wherever machines, lighting or portable tools require voltage changes, you'll find G-E Dry-Type Transformers saving power dollars.

They save by putting the right voltage close to the load. By eliminating long runs of low-voltage secondary feeders, these transformers cut power losses, conserve copper.

And you can mount lightweight G-E Transformers on platforms or wall brackets to save valuable floor space. Solderless connectors on the higher ratings simplify installation—no more splicing, soldering or taping.

G-E Dry-Type Transformers can save power dollars in your industry, too. Ask your nearby authorized G-E distributor to show you how. Or write for bulletin GEC-868A, Section 411-104, General Electric Company, Schenectady 5, New York. **PORTABLE-MOUNTED** G-E Transformers at Kaiser wartime shipyards supplied low-voltage power where



ELECTRIC

PLATFORM-MOUNTED bank of G-E Type D Transformers provides correct power at the

load for sewing machines at Burton-Dixie Corporation, mattress manufacturer in Dallas.









#### "It's foolish to try to be bigger than you are"

REMEMBER Aesop's fable of the frog and the ox? Told 2,500 years ago, it goes:

"Three young frogs cried to their mother that a little brother had been trampled by the largest beast in the swamp. 'Oh, no,' said the mother, 'no beast is larger than I.' And she blew herself up to show how big she really was. 'But it was much bigger,' the little ones chorused. Whereupon the vain mother inflated herself until she burst." And the moral was, "It's foolish to try to be bigger than you are."

Aside from the wisdom of the fable for each of us individually, there is solemn warning for us as a nation. Some among us seem to believe that with an unlimited supply of taxpayers' dollars America can buy anything—ease and

security at home, acceptance of our ideas abroad, friendship of other peoples, even world peace.

Like the vain frog, America inflates herself more and more dangerously, trying to stretch herself to be the biggest thing in the swamp. Meanwhile the enormous beast that is the world goes its own way, scarcely affected by the vainglorious display of America's inflation. It's the same old world that was indifferent before the pomp of Egypt, Persia, Greece and Rome.

How will our present "puffing" end? Isn't it obvious that continued inflation can bring disaster? Only by a realistic policy of living within our means—not trying to be bigger than we are—can America avoid the catastrophe of Aesop's foolish frog.



#### The Youngstown Sheet and Tube Company

General Offices -- Youngstown 1, Ohio
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MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment

## For Reduced Maintenance Costs Fluorescent Starter

BRYANT

STANDARD

each Bryant starter is individually inspect

Order your asyant starters from this handy subsctor chart. A complete line for every application

LAMP SIZE, WATTS	4, 6, 8	15, 20	25 Circlard	30, 40	32 Circline	85, 90, 100	85, 90, 100
	NAM CANADA	MYAN PRATER ES 2 SETTIFIES	MYATE	INYAH PAATE PAATE PAATE PAATE PAATE PAATE	BRYANT	IRYAN STARTES FS-85	IRYANT IRYANT IRYANT IRVANT
CATALOG NUMBER	FSS	FS2	F825	FS4	FS12	F585	FS85-4

"NO-BLINK" AUTOMATIC RESET TYPE

LAMP SIZE

CATALOG

NUMBER OF

Restores circuit as soon as new lamp

NUMBER OF PINS

LAMP SIZE, WATTS 40

CATALOG FS4-NA
NUMBER OF PINS
2

30

BRYANT STARTED STARTED STARTED

FS85-NA

85, 90, 100

BRYAN DE ARTHUR DE ARTHUR DE ARTHUR DE ARTHUR MONTO DE MONTO DE MONTO DE

85, 90, 100

FS85-NA4

"NO-BLINK" MANUAL RESET TYPE

Circuit restored by pushing small red button in top of starter, after new lamp has been installed. 14個臺灣市

15, 20

F520 F530

BRYAN GRAFTEN GRAFTEN TO GRAFTEN TO GRAFTEN

FS40

40



FS850



Listed as Standard by Underwriters' Laboratories, Inc.

THE BRYANT ELECTRIC COMPANY . BRIDGEPORT 2, CONNECTICUT . CHICAGO . LOS ANGELES

## CRESCENT



Has These Additional Features

Which Makes Installation

EASIER - QUICKER - SAFER



Permanently low armor resistance is provided in sizes No. 14 and 12 AWG by use of a flattened, bonding wire which is in contact with the under side of each convolution.



The Cut Mark (at 1½" intervals) shows the location of a prefabricated breaking line inside the armor. Only a few strokes of a file or saw guided by the Cut Mark are required to cut through one outer ridge, and a bend by hand severs the armor. This results in a clean separation with no sharp edge—a safer, easier and faster job. The prefabricated breaking lines are so designed that there is no reduction in tensile strength, bending quality, crashing resistance and electrical conductivity of armor.



FILE OR SAW



PULL OUT PAPER



INSERT BUSHING

In the last 24 years alone, over SEVEN BILLION FEET of Armored Cable have been produced by the industry. Armored Cable provides the only general purpose, factory-assembled and tested, metal protected wiring system.



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QUALITY ELECTRICAL

## TAPES

Ensy Tear-Off Migh Tonsile Strengti

BLUEPRINT FOR KNOW-HOW! For over a quarter computation for spatialist

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Common the following the familier ACCURATE and the familier ACCURATE and the familier ACCURATE. For complete catalog, call or write-

ACCURATE FRICTION TAPES



Quality made of highest grade rubber and finest cotton base. Affords maximum mechanical protection. Available in Standard and A.S.T.M.-A.A.R. Specification grades.

> ACCURATE RUBBER TAPES



Offers high elasticity, excellent cohesion, high dielectric strength and super aging qualities; made in both Standard and A.S.T.M.-A.A.R.

\*\*\*\*\*\*\*\*\*\*\*\*\*

TAPE TIPS: FOR ELECTRICIANS

Use rubber tape that coheres without heat or extra pressure. That's Accurate Tape! Easier to apply and actually improves with age. Remember — it's Accurate Rubber for greater electrical strength, Accurate Friction for positive mechanical protection!

ACCURATE PLASTIC TAPE



Thin caliper reduces bulk in sight spots. Strong mechanleatly and offers high dielectric strength. Recommended for use wherever plastic tape is practical.

ACCURALE YOUR BEST BUY IN TAPE

MORE THAN A QUARTER CENTURY OF TAPE SPECIALIZATION

## By REQUEST!



#### TAKE A LOOK AT THESE!

new



FOUR-pole, TOTALLY enclosed motor in both the 8" and 10" ventilator. Result: increased air delivery at a lower motor speed, with greatly reduced noise level.

new



FIVE-petal deep pitch blades on the 8" ventilator give more air at lower noise level.

new

### FASCO

presents TWO entirely NEW Wall Ventilating Fans

(MODEL "847" AND "1047")

## YOU asked for!

It's true—YOU designed these new ventilators! Even before engineering started, we asked contractors and builders from coast to coast—"What changes should we make in redesigning our current wall vents?" Your answers have been incorporated in 6 NEW FEATURES which make these ventilators far more efficient and far easier to install and maintain.

AND... all these additional features at no extra cost to you!

a

An entirely new grille design, modern in appearance, easy to clean. Can be removed in a matter of seconds, without tools, by loosening one thumb screw. Grilles available in white enamel or chrome.

- new



Outside Junction Box, accessible for quick, easy wiring. Electrician's job completed at time of rough wiring—and . . .

- new



New Separable plug design allows installation and removal of fan blade and motor without tools or disturbing the wiring.

15- n



Adjustable motor bar permits easy alignment of grille after installation.

FREE COMPLETE SPECIFICATION SHEETS... WRITE TODAY!

FASCO Industries, Inc.

207 AUGUSTA STREET, ROCHESTER 2, NEW YORK

## Lighting where and when it's needed ... without rewiring!



Safe. Sturdy. Current-carrying Trol-E-Duct bus bars are totally enclosed. Duct itself (arrow) supports fixtures. Continuous slot in bottom of duct means you can move lights (or small portable tools on trolleys) anywhere, any time without rewiring. It's every inch an outlet!



Quickly installed. Sections go up in a hurry, join without bolting. Sections are prefabricated, standardized in lengths of 5 and 10 feet. Entire duct can be dismantled and reinstalled easily without a scrapped part.



Convenient. Lighting twist-out plugs slip into duct without cutting off power or upsetting production schedules. Plugs ground on steel casing before contacts touch bus bars, slide in with simple twist anywhere along duct.



Mobile Trolleys. Smooth-rolling trolleys are available to carry small, portable power tools, speed up production. Trolleys ride inside duct on metal wheels. Constant spring pressure against bus bars assures perfect contact.

#### Now, with Universal Trol-E-Duct, you can offer modern, fully flexible lighting. For faster sales, easier installations, more profits for you!

**Customers** go for a lighting system that's up to date, adapts in minutes to changing needs without rewiring . . . cuts maintenance costs to the bone, as well.

BullDog Universal Trol-E-Duct is just such a system. It provides *truly mobile*, *fully flexible* lighting. It is completely standardized for great economy of installation and operation.

Every inch of Trol-E-Duct is a potential tap-off for lights or small power tools. To move lights or add new ones, twist-out plugs or trolleys are slipped in or out of continuous slot in bottom of duct. No rewiring needed. No production lost through shutdowns. No wasted man-hours or scrapped materials either.

Trol-E-Duct is prefabricated, standardized and salvable. Installs in a hurry. Can be dismantled and reinstalled without loss.

Get all the facts on this modern, low-cost lighting system that fits your customers' present needs, provides for their future needs, as well. Contact your nearby BullDog Distributor. Or, for descriptive bulletin, write BullDog direct, won't you.

#### BULLDOG ELECTRIC PRODUCTS COMPANY

DETROIT 32, MICHIGAN . FIELD OFFICES IN ALL PRINCIPAL CITIES IN CANADA: BULLDOG ELECTRIC PRODUCTS OF CANADA, LTD., TORONTO

PIONEERS IN FLEXIBLE ELECTRICAL DISTRIBUTION SYSTEMS



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#### COPE Cable Trough is Used by Utilities and Industrial Plants Throughout the World

The ease and economy of installing standard COPE Cable Trough has given it wide acceptance among the leading utilities and industrial plants around the globe. They realize, as will you, how COPE Cable Trough saves on time, material and costs.

Write for full information.



COPE Cable Trough Installation at Gary Sheet & Tin Mill—U. S. Steel Company

#### A few of the Users of COPE CABLE TROUGH ...

Allis-Chalmers Manufacturing Co. Aluminum Company of America Atlantic City Electric Co. Atomic Energy Commission Borg-Warner Carp. The Budd Company Carolina Power & Light Co. Central Hudson Gas & Electric Corp. Cincinnati Gas & Electric Co. Cleveland Electric Illuminating Co. Commonwealth Edison Co. Connecticut Light & Power Co. Consolidated Gas, Electric Light & Power Co. of Baltimore Delaware Power & Light Co. Detroit Edison Co. Detroit Steel Corp. Dow Chemical Co. E. I. du Pont de Nemours & Co., Inc. **Ethyl Corporation** Ford Motor Company Goodyear Tire & Rubber Co. Indianapolis Power & Light Co. International Harvester Co. Island of Iceland Jersey Central Power & Light Co. Jones & Laughlin Steel Corp. Kaiser Aluminum & Chemical Corp. Kansas City Power & Light Co. Kingdom of Egypt Kingdom of Greece The Mead Corporation Monsanto Chemical Co. Monongahela Power Co. and The Potomac Edison Co. National Advisory Committee for Aeronautics National Aniline Div., Allied Chemical & Dye Corp. **New England Electric System** New York State Electric & Gas Corp. Niagara-Mohawk Power Corp. Pacific Gas & Electric Co. Packard Motor Car Co. Pennsylvania Electric Co. Philadelphia Electric Co. Pittsburgh Plate Glass Co. Republic Steel Corp. Reynolds Metals Co., Inc. Southern California Edison Co. Union Electric Co. United States Army—Corps of Engineers United States Bureau of Reclamation United States Navy United States Steel Co. Virginia Electric & Power Co. WCAU-AM-FM-TV, Phila.



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Western Electric Co., Inc.

CONTROL

Engineered

for the cement industry

ALLIS-CHALMERS Type H starters en-

gineered for these applications provide complete control plus protection of

motors, machines and personnel. Cur-

rent limiting fuses, relays, instruments

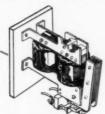
... everything needed is built in. Heart

of every synchronous starter is the Type

230 field application relay.



**CEMENT MAKING** requires controlled power for dependable, continuous operation of slow speed processing machinery operating in dusty atmospheres — often under adverse voltage conditions. Finish grinding of cement clinker in this *Ballpeb* mill, for example, needs a 550-horsepower synchronous motor and a 2300-volt starter designed to give complete protection to the motor.



DC EXCITATION is applied by this relay at the exact half cycle when proper rotor speed is reached. It maintains excitation during normal operation . . . removes excitation on motor pull-out . . . resynchronizes motor if pull-out condition is corrected before protective devices disconnect motor from line.





HIGH VOLTAGE starters may have either oil-immersed or air-break primary contactors as standard. Both types are designed for ready access . . . built to give long life with low maintenance. The selection of contactors for every Allis-Chalmers controller is based strictly on job requirements.

#### **ALLIS-CHALMERS**

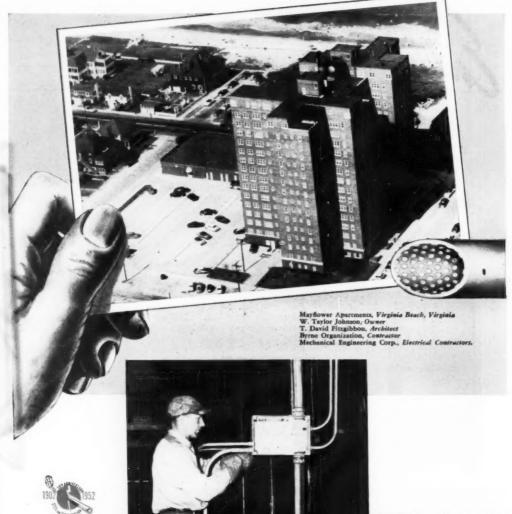
Ballock is an Allis-Chalmers trademark

There are Allis-Chalmers controllers for use in every industry . . . starters for squirrel-cage, wound-rotor and synchronous motors. For starters up to 2500 bp at 5000 volts—check with your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wis., for Bulletin 1486410A.



A-071

### ".. have a wonderful apartment right on Virginia Beach .."



Inside-knurling, an Electronite E.M.T. exclusive feature, makes wire-pulling as much as 30% easier.

#### REPUBLIC STEEL CORPORATION

STEEL AND TUBES DIVISION
224 EAST 131st St. • CLEVELAND 8, OHIO

## and ELECTRUNITE E.M.T.

## helps keep electrical work-savers working



Ideas he gathered from inspecting apartment buildings in Washington, New York, and Miami helped W. Taylor Johnson make "The Mayflower," at Virginia Beach, one of the finest ocean-front apartments in the South.

ELECTRUNITE E.M.T., the light-and-strong steel raceway that protects all electrical circuits, call systems, and television leads from moisture, fire, and mechanical injury, helped him carry out these ideas.

Contractors rate ELECTRUNITE E.M.T. first in brand preference. It's inspected by Underwriters' Laboratories, is approved by the National Electrical Code for exposed, concealed, and concrete-slab installations.

Experienced electricians take pride in the jobs they do with ELECTRUNITE E.M.T., the raceway that is engineered for easy installation. It's easy to cut and bend accurately ... exclusive "inch-marked" lengths are the reason. No runs to turn ... quick, threadless connections make concrete-tight joints. And it's easy to pull-in wires along the exclusive inside-knurled walls. Ask for ELECTRUNITE E.M.T. by brand at your distributor's.



## Here's How HART-LOGE

Adds up for YOU

- MODERN INDUSTRY IS USING MORE AND MORE PORTABLE ELECTRICAL EQUIPMENT . . .
- THIS MEANS THE INCREASED USE OF SEPARABLE CORD CONNECTIONS . . .
- FOR EFFICIENT, UNINTERRUPTED PRODUCTION, SEPARABLE CONNECTIONS NEED INTERLOCKING WIRING DEVICES TO PREVENT ACCIDENTAL DISCONNECT . . .
- A THE NEWEST, MOST IMPROVED Interlocking Wiring Devices



MANUFACTURED BY THE ARROW-HART & HEGEMAN ELECTRIC COMPANY

AVAILABLE IN 2-, 3- and 4-WIRE CAPS, CONNECTORS, PLUG BASES, MOTOR BASES, MOTOR PLUGS and FLUSH RECEPTACLES FOR 20 AMPS. 250 V., A.C. or D.C. - ALSO 3- and 4-WIRE, 10 AMPS. 575 V., A.C.

#### CHECK THESE FEATURES-

OPTIONAL BACK WIRING

Quicker and easier to install. Connections are neater and safer. Handy Wire Strip Gage on back plate instantly gives exactly correct lengths. EXCLUSIVE "CONTROLLED-TENSION" INNER CONTACTS

U-type, one-piece construction of heavy bronze with single staking is lasts longer . . . more efficient electrically.

RUGGED CONSTRUCTION

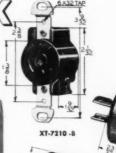
Heavily constructed of only top quality materials for long life under severe conditions. Ferrous metal parts are heavily zinc plated for carrasian resistance.

ADAPTABLE

Interchangeable with older type interlacking devices. Grounding models available. Receptacles and connectors will accommodate polarized or nonpolarized caps.

It gives you the ELECTRICAL CONTRACTOR . . .

1. the best possible devices to meet the needs of your industrial customers SO SEE YOUR ELECTRICAL DISTRIBUTOR TODAY. ASK HIM TO SHOW YOU THESE NEWER, BETTER INTERLOCKING DEVICES.





XT-7313



XT-7102















For complete information on the HART-LOCK Line, send today for your copy of this fully illustrated bulletin your customers will want to see it too. WRITE TO 1708 LAUREL STREET, HARTFORD 6, CONNECTICUT. Branches in: BOSTON, CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK, PHILADELPHIA, SAN FRANCISCO, STRACUSE, In Canada: ARROW-HART & HEGEMAN (CANADA) LTD., MT. DENNIS, TORONTO 15, ONTARIO.

WIRING DEVICES **ENCLOSED SWITCHES** 



HART & REGEMAN DIVISION THE ARROW-HART & HEGEMAN ELECTRIC CO.

## STANDARD

### CUSTOM

#### ... CAST BOXES' BY HOPE

#### STANDARD TYPES & SIZES



UNFLANGED BOXES H1 200 Type 164 sizes from 4 x 2 x 2 to 48 x 36 x 17



FLAT FLAMGED BOXES H8000 Type 87 sizes om 4 x 4 x 3 to 36 x 36 x 12



HINGED COVER BOXES
H3200 Type
128 sizes
from 5 x 5 x 3 to 36 x 36 x 12



FLAMGED RECESSED COVER BOXES H7000 Type 51 sixes from 4 x 4 x 3 to 30 x 24 x 12



CHECKERED COVER SIDEWALK BOXES
H5800 Type
53 blacs
from 6 x 6 x 4 to 36 x 24 x 14

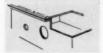
STANDARD BOXES are of strong, dones cost from—but dip galvonized for long service and attractive appearance. Weetherproof construction—rubbor-gasketed clasure prevents entry of rain, snew, sleet or dust under normal conditions.

#### **CUSTOM VARIATIONS**

You can specify any of these modifications in standard BOXES by MOPE

-have them factory-made at moderate cost-and get prompt delivery.

DRILLING—
or drilling and tepping—
of conduit entrances



BOSSES-

to provide extra thickness for five-thread conduit entrances. Drilled and tapped to specification if desired



SPECIAL GASKETS -

Meaprene for fungus resistance in het, humid climates « pure gum for extreme softness and resistance to special acids « Yellumoid for resistance to ails and fats « graphite-free compressed asbestes for installation near boilers or steam pipes



MOUNTING LUGS drilled for any desired belt size



-tapped blind to specified centers



AND . . . you can order these custom modifications, as well as standard BOXES by HOPE, conveniently and quickly, through your local electrical distributor.

. OUTLET BOXES AND FITTINGS . JUNCTION AND PULL BOXES . HINGED CABINETS . TERMINAL BOXES . EXPLOSION HOUSINGS

## HOPE ELECTRICAL PRODUCTS CO., INC.

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#### **EXPLOSION HOUSINGS BY HOPE**

have been extensively used in Class 1, Groups C and D hazardous locations, such as chemical, petroleum and powder plants, pump rooms and paint plants.

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WRITE ON COMPANY LETTERHEAD FOR CATALOG

## On the for FIBRE CONDUIT

#### Always Profitable to the Contractor



The Trend is to go underground. Where direct burial is practical. Orangeburg NOCRETE is ideal because it has beavier and thicker walls for one and two duct installations without concrete encasement. Serves factories, schools, colleges, hospitals, drive-in theatres, power and telephone systems, also service entrances. airports. Orangeburg NO-CRETE saves time, work and money for the contractor.

In every city and state there is a well defined preference for Orangeburg STANDARD, installed with concrete where banks of three, four or more ducts are required. Orangeburg STANDARD is widely used by utilities, municipalities and industry. For 58 years it has been a favorite of design engineers and contractors everywhere.

Quality, dependability and profitable ease of installation has won for Orangeburg STANDARD nationwide approval.



STANDARD Installed with Concrete

**NOCRETE** Installed without Concrete

No special tools needed Orangeburg is easily worked in the field, easily sawed, easily tooled with an inexpensive lathe, Long light lengths saves time speeds up the job.



#### **Taper-Sleeve Joints** stay tight

The joints are surprisingly easy to make. A few light hammer taps drive them up tight. Corrosive ground waters do not enter. These Tapered Sleeve Joints are famous because they stay tight permanently.



#### Less Breakage

Orangeburg is tough, resilient and ruggedseldom breaks when handled with ordinary care. This is added insurance of a good profit-without little losses to write off.

#### **Bigger Payloads**

Big capacity truck loads of Orangeburg are easily hauled without damage - and with fewer trips. The transportation costs are low the job is speeded up - good profit points for the contractor.

#### **Outstanding Features**

Orangeburg lays faster and at lower cost than any other type of conduit. Impermeable wall and tight joints keep out corrosive ground waters . Low coefficient of friction keeps pulling tension on cable to minimum . Protects cable sheath from abrasion when nulled in . Resists acids, alkalies, salt, grease and oil · Light, easy to handle and tool in the field.

#### Send for Bend Section Folder

This shows ingenious ways to get around trouble spots with Orangeburg Bend Sections. Folder sent FREE on request.

New Catalog 51 is also available. Write to Dept. EC8 for this booklet which tells the story of Orangeburg Fibre Conduit - both STANDARD and NOCRETE, Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y.

NOW BRANDED WITH ORANGEBURG TRADEMARK



DISTRIBUTORS CRANCEBURG FIRRE CONDUIT



ANCHES AND STOCKS IN PRINCIPAL CITIES

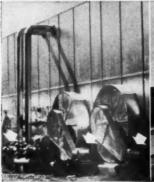


### Large or Small...

Century

Are Designed to Provide All the Performance That Is Built Into the Machines They Drive





Century splash proof motor's driving fans out in the open, without any protection.



75 Horsepower Century drip proof motor on a copper tube drawing machine.



Century 125 Horsepower motors on circulating pumps for chilled water.

Used in department store.



Here are some typical examples of requipment powered by large Century motors, which were application engineered for TOP PERFORMANCE.

Matching the operating characteristics of your equipment is made easy through Century's wide line of single phase, polyphase and direct current motors to choose from. They are made in many types, ranging in size from 1/8 to 400 horsepower, with literally hundreds of specifications adaptable to specific applications.

Get Top Performance of your equipment through skillful motor application by specifying Century motors on the equipment you buy and for replacement.



# Rare gases boost light of new Westinghouse



YOU CAN BE SURE ... IF IT'S

## Westinghouse

## and efficiency 90 watt lamp

The light and efficiency booster in the new Westinghouse 90-watt fluorescent lamp is kryptonargon. This gas fill, exclusive with Westinghouse, takes only 2% more current to jump light output 6%. And after 7500 hours, this new lamp will still outshine every other lamp in its class.

The new 90-watt will fit your present 85-watt or 100-watt fixtures. It will hold the level of light above your minimum foot candle value longer. It'll reduce your yearly cost of light.

It has many other advantages. For one thing, with the new 90-watt, the ballasts run cooler because of lower wattage loss. But why not write us for more information. Just mail the coupon, or call your nearest Westinghouse Lamp Sales Office.

WESTINGHOUSE LAMP DIVISION, BLOOMFIELD, NEW JERSEY

**TUNE IN ON HISTORY!** Only Westinghouse brings you complete coverage of four-month political campaign over CBS television and radio.

## NEWS FROM WESTINGHOUSE, THE FASTEST-GROWING LAMP MANUFACTURER

by Sam Hibber



HOW BRIGHT IS LIGHT? The "level" of illumination in offices and schools is usually around 25 footcandles; June sunlight outdoors is nearly 9,000 footcandles! Compare it this way: At least 950,000,000 light bulbs are sold each year, averaging about 80 watts. Perhaps three billion are available in the U. S. for use at any one time. Now! If all of them were burned at once, over a flat field, they could equal bright sunlight over less than ten square miles of land!

EXCEPTION, PLEASE! Some of those three billion lamp bulbs aren't supposed to give light. For instance, there is the Westinghouse Odorout ozone-producing bulb in which the dim blue light is incidental to the ozone-making waves. Many appliance makers (refrigerators, home freezers, washers) have built the Odorout into their product to purify the air. Westinghouse engineers have cooperated fully with them; such problems are always welcome here at Westinghouse.

colored light: Some jokesterscientists once lit a banquet hall with cadmium vapor lamps which looked normal, but produced mostly red and blue-green light. This turned peas and meat black, milk red, celery pink, olives blue. The guests ate aghtly; the fine food tasted awful, several guests were ill. The eyes had won over all other senses combined.

All light has color, of course, and must be chosen with discrimination. Today, fluorescent lights are available in controlled colors. Now, over a dozen different standard colors and tints are available in Westinghouse fluorescent lamps.

More later

Barnuel 9 Sillem

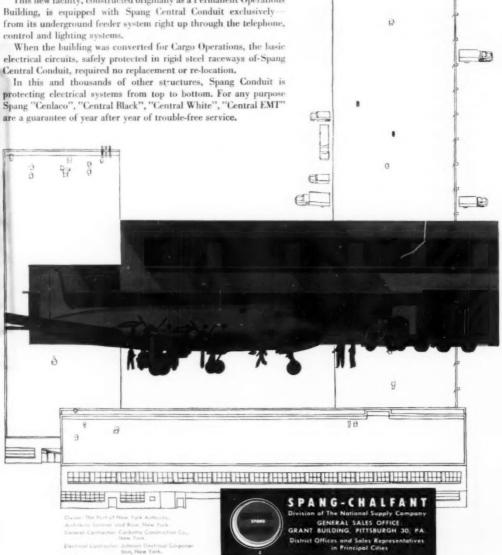
BUY NOW AND SAVE!
WESTINGHOUSE
FLUORESCENT LAMPS
STILL COST YOU LESS
THAN THEY DID
IN 1940, YET BURN
SEVEN TIMES LONGER!

#### SPANG CENTRAL CONDUIT

serves IDLEWILD'S newly completed air freight terminal

Air cargo tonnage passing through New York International Airport increased so rapidly during recent years that existing facilities were heavily over-burdened, until The New York Port Authority opened the new Cargo Operations Building late in 1951.

This new facility, constructed originally as a Permanent Operations Building, is equipped with Spang Central Conduit exclusively



## Aid or Trade? A CRISIS AHEAD

A crisis in the foreign trade relations of the United States is in the offing. It is a crisis caused by:

- Efforts of producers in friendly nations to earn more dollars by increasing exports to the United States, and
- Efforts of industries in the United States which would be hurt by competition from these imports to keep them out

This crisis is a threat to the effectiveness of American leadership in the crucial effort to build the nations of the free world into a strong and unified group. It is the purpose of this editorial to advocate a constructive approach to the difficult situation that is developing.

#### **Background of the Crisis**

Most countries in the free world—with American aid—have managed to push their outputs well above prewar levels. As they have done so, they have been urged by our highest government officials to increase their exports to us. Sales in our market enable these countries to earn dollars which they use in turn to buy the products of America's farms and factories. Thus, as they become self-supporting, the need of American aid is reduced.

But as these efforts to export more to the United States have promised increasing success, competitive American producers have become increasingly alarmed about what that success might do to them, Consequently, they are seeking more protection—by appeals to the U. S. Tariff Commission to recommend higher import duties and by appeals to Congress for new laws to discourage imports.

#### **Our Friends Protest**

A year ago Congress answered one of these appeals by imposing a quota on imports of dairy products. Now, among many other legislative proposals being strenuously pressed is a move to extend the scope of "Buy American" legislation. A year ago the U. S. Tariff Commission had only four petitions for increased import duties on its docket. Since then fourteen more petitions have been filed and others are definitely on the way.

Faced by these mounting efforts to block the sale of their products in the American market, no less than eleven friendly nations, including Great Britain, France, Italy, Canada, the Netherlands, Switzerland and Denmark, have filed protests with our State Department. Through many of the protests runs one refrain. Although stated in diplomatic language, it might be correctly paraphrased to say: "In

sending us aid you have made it very clear that you want us to get on a self-supporting basis at the earliest possible moment. But, when we begin to make headway in that direction by trying to sell you more of the things we are equipped to produce, you start closing your market to us." The threat of European resentment against the United States being stirred up by this argument is obviously great.

At the same time there exist grounds for special resentment in the United States against certain prospective imports of European manufactured goods - those of machine tools, for example. In part these will be produced with machinery that has been sent to Europe as part of our economic aid program, With absolutely no diplomatic language involved, the argument, which will be extended much farther than the facts would justify, will run: "We gave those people the equipment that they now use to cut our throats!" This line of argument will find response among workers as well as employers in industries faced by more competition from imports. Labor, too, is keen for protection against more foreign competition.

#### Aid or Trade?

As between continuing direct economic aid to Europe or accepting the imports that would make those countries self-supporting, some would prefer to continue the aid program. They argue that the tax machinery of the federal government can spread the burden of aid broadly, while we have no comparable machinery that can cushion the shock to individual industries, firms and communities that may result from stepped-up imports of competitive products.

As we see it, this position is untenable. It would make rubbish of our Atlantic Charter promise "... to further the enjoyment by all States, great or small, victor or vanquished, of access, on equal terms, to the trade and to the raw materials of the world which are needed for their economic prosperity." It would be an admission that, for all our profession of faith in competition and our opposition to

European cartels, we really don't believe in competition

#### U. S. Self-Interest

The people of this country have invested billions of dollars and seven years of hard work in the attempt to put our allies on a self-supporting basis. If we keep their goods out by raising trade barriers, we are directly defeating our own purposes.

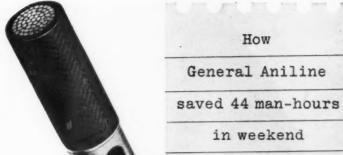
Also, in moving to protect some groups of American producers we should be hurting others. For many American producers the export market, which this year will take about \$14 billion of civilian goods, spells the difference between operating at capacity and closing down 25% of their facilities. When we discourage imports we cut off dollar earnings by other nations which are spent here to keep some of our factories and farms going.

At the same time, it must be recognized that certain American industries and their capacity to maintain employment will be hurt by increased imports. Hence it becomes critically important for the United States to formulate a national program designed to help these industries and communities take up the shock.

There is no neat and simple prescription by which this can be done, but several possibilities have been suggested. One on which there is general agreement is that tariff reductions should be gradual. To cushion their impact, the government might well give preference on defense orders to industries and areas adversely affected by an increased volume of imports. Direct assistance to workers and companies in shifting to different lines of business may be worth consideration.

These are by no means all the possibilities. They may not even be the best. But they do serve to suggest the necessity for flexibility and imagination in dealing with the growing crisis in trade relations. Our ingenuity in developing new ideas to meet this crisis may well be a decisive factor in our effort to weld the free nations into a strong and durable alliance.

McGraw-Hill Publishing Company, Inc.



overhaul

HYLINKS 44 man-hours saved!

electrical

Annual factory shut-down for electrical overhaul and maintenance is a growing trend because it permits major work to be done more quickly, safely, cheaply, with minimum interruption of production.

During the last such overhaul at the General Aniline Works in Graselli, N. J.—Labor Day weekend—one of the big discoveries was the time saved by using Burndy Hydent connectors on their large power feeders!

"More than 44 man-hours were saved on installations. The smooth surface of the connector permitted faster taping of the connection, since there were no protruding nuts or bolts to be covered. These connectors permitted the use of smaller junction boxes."

(Factory, pg. 104, December '51)

Whether you're doing annual overhauls or year-round maintenance, Burndy Connectors and installation tools —in every size, type, and service—help electrical engineers and crews do an important job better!



. . . . . .

2-18 BURNDY ENGINEERING COMPANY . NORWALK, CONNECT

HYPRESS

GRONTO 8. ONT.



Compare A.V.C. with Type RH in a 250 MCM size\*



- you use 2½" conduit for both
- you use the same size fittings and lugs
- you have the same installation costs
- BUT Type RH carries only 224 amperes whereas higherrated A.V.C. carries 296 amperes—a 32% increase in capacity.

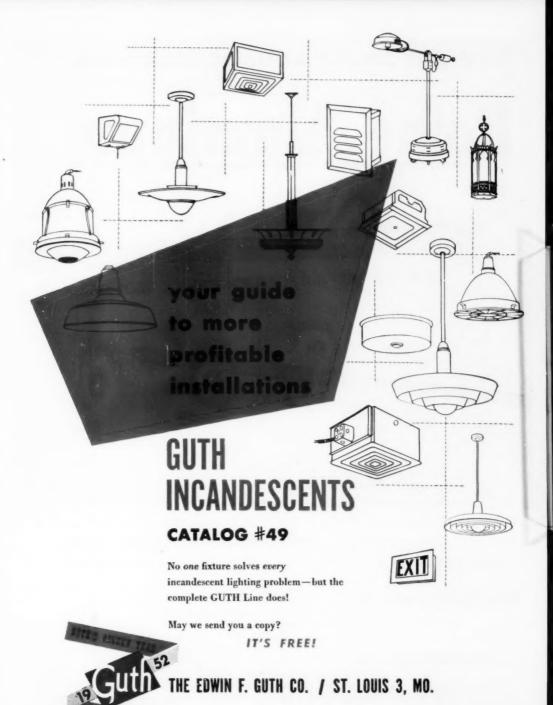
For more efficient current-carrying capacity, always specify Rockbestos A.V.C. Write for the booklet "Cut Current Carrying Costs."

\*From Chapter V - Notional Electrical Code -- 3 conductors in conduit -- 40°C-104°F.

### ROCKBESTOS A.V.C.

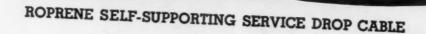
ROCKBESTOS PRODUCTS CORPORATION

NEW YORK CLEVELAND DETROIT CHICAGO PITTSBURGH ST. LOUIS LOS ANGELES OAKLAND, CAL.



## You get these advantages with

# Rome Aluminum



# ROPRENE OR ROLENE LINE WIRE

### 3 BIG REASONS...

Why you are bound to save money with Rome Aluminum Self-Supporting Service Drop Cable and Rome Aluminum Line Wire... lower purchase cost...lower installation costs...longer service life.

- **Lower purchase cost...** Depending upon the service involved, aluminum conductors cost less today.
- Lower installation costs... Aluminum's lighter weight means easier and cheaper handling . . .
  in many instances permits longer spans with fewer poles. The simplicity of Rome's Self-Supporting Cable construction means increased savings through cheaper hardware and ease of installation.
  - Longer service life... Aluminum has proved itself as a long-life conductor material. RoPrene
    (Neoprene) as well as RoLene (polyethylene) as either insulation or
    covering has exceptional resistance to sunlight, moisture, corrosive
    atmospheres and abrasion. With no braids to rot and festoon, replacement is minimized.



### **Rome Aluminum Self-Supporting Service**

Drop Cable is regularly supplied with two Ro-Prene (Neoprene) insulated power conductors of solid aluminum, spiralled around a bare neutral messenger of ACSR (aluminum conductor steel reinforced). This time-proven construction provides high strength, simplicity of installation. Rome Aluminum Line Wire is available with covering of RoPrene (Neoprene) or RoLene (polyethylene) as specified. Here is low cost Line Wire having ease of handling, as well as long, non-festioning service life. Uniformly small diameters provide neater appearance, plus reduced wind and ice loading.



It Costs Less to Buy the Best

## ALUMINUM

ROME CABLE CORPORATION, ROME, N.Y., AND TORRANCE, CALIF.

# B-M Fittings ARE APPROVED AS CONCRETETION









BRIEGEL METHOD TOOL CO.

Distributed by

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## Whatever the job you're right with a DEICO Whether you need totally enclosed or openend motors . . . fan cooled or explosionresistant motors . . . you're certain to get the right motors on the job when you choose 12. 6 4 Each and every Delco motor is designed and built for the job it has to do. It's made of the finest materials, and engineered to stand up longer under the roughest conditions. So check up on Delco motors, now. You'll find Delco has the motors you need, and that Delco always meets its commitments. For full details, write to Delco Products, Dayton, Ohio, or call the nearest sales office listed below. DELCO FEATURES MAKE DELCO FINEST **DELCO PRODUCTS** Division of General Motors Corporation Dayton, Ohio







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## Fusetron Fuses

They provide 10 Point Protection

- 1 \*Protect against short-circuits.
- 2 Protect against needless blows caused by harmless overloads.
- 3 Protect against needless blows caused by excessive heating lesser resistance results in cooler operation.
- 4 Provide thermal protection for panels and switches against damage from heating due to poor contact.
- 5 Protect motors against burnout from overloading.
- 6 Protect motors against burnout due to single phasing.
- 7 Give DOUBLE burnout protection to large motors without extra cost.
- 8 Make protection of small motors simple and inexpensive.
- 9 Protect against waste of space and money permit use of proper size switches and panels.
- 10 Protect coils, transformers and solenoids against burnout.

\*Fuserron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.



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Delay may cost you more than replacing every ordinary fuse with a FUSETRON dual-element Fuse — but by passing the word along that all purchase and stock records should call for FUSETRON dual-element fuses, you have action that begets money saving.

SEND THE COUPON FOR MORE FACTS Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo. (Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

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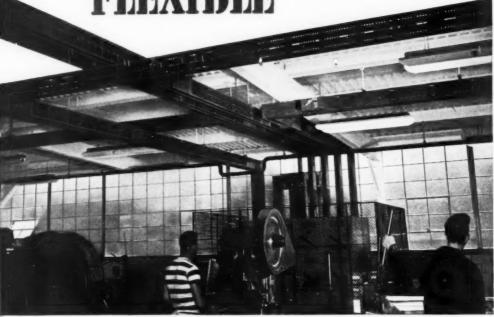
Company

City & Zone \_\_\_\_\_ State\_\_\_\_ECM-8-52

(FUSETRON is a trade mark of Busemann Mfg. Co., Division McGraw Electric Co.)



BUS DUCT IS FLEXIBLE



# "It's So Flexible To Plant Layout..." says The Randall Company

The Randall Company officials stated, "It's so flexible to plant layout and production line shifts that it's just what we need for future changes and expansion."

"The ease of installing your Bus Duct was amazing ... it saved us both time and money," said the contractor, Mr. Edward P. Fogarty, President of Fogarty Electric Company, Cincinnati, about this job.

This large installation of Westinghouse Low Impedance and Plug-In Bus Duct is in the Randall Company plant at Wilmington, Ohio. It is assembled from standardized sections that allow rapid dismantling and reassembly without waste of time; duct is fully salvageable.

Up to 5,000 amperes, Westinghouse Bus Duct provides more power per pound of equipment than any system of wireway, cable or conduit. Four types are available to handle all load requirements, meet all service conditions in your plant or, building from power source to outlet.

Get complete facts by calling your Westinghouse Distributor or write for B-4272-A, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

-30108



# **Washington Report**

Settlement of the steel strike on July 24 came just in time to prevent complete disruption to military and civilian production and serious crippling of the national economy. Defense chiefs, really worried over production slow-down and rapid depletion of stockpiles—over 300 defense plants had been closed or had drastically cut production—were urging seizure of steel mills under provisions of the Selective Service Act. They claimed the strike did more damage to armament production than "any bombing raid" would have done.

Cost of strike during the 53-day walkout was estimated at 17-million ingot tons of steel, and \$4-billion in lost production and wages. Losses continued over reopening period in the steel mills, and many steel-using producers are still feeling the effects of the close-down. Both military and civilian metal-starved factories are reported two months behind schedules.

End of CMP controls on steel, originally planned for next January, will now be up-dated to at least next July. Meantime, steel production loss during the strike guarantees capacity production for many weeks ahead.

The big question for NPA (as this is written at press time) is how to divvy up the new supply of steel as it rolls from the mills. Best bet is that directives will be used to insure steel for: 1) military end items and components; 2) AEC orders; 3) machine tools and tinplate for canning perishable foods; and 4) civilian users (auto, appliances, etc.) whose shutdowns for lack of steel have caused major unemployment. The pinch on steel will probably extend over most of the remainder of this year, keep steel mills operating at full capacity into early months of 1953.

Rigid electrical conduit supply is in tight supply, but EMT was less affected by the steel strike. Fittings are in ample supply and should remain so. There is an approximate 45-day supply of low voltage distribution equipment, NPA officials indicate, but layoffs had already been made in many plants due to both lack of steel and slowdowns in new orders. Production disruptions caused many manufacturers to return CMP allotment tickets for both 3rd and 4th quarters, which may help ease the situation.

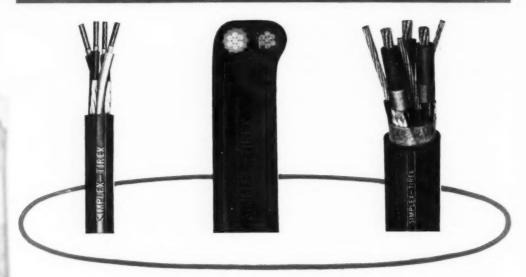
Extension of mobilization controls was finally approved by Congress during its hectic closing days in early July, in a modified Defense Production Act of 1950. Production controls are extended through June 30, 1953, while price-wage controls are to be terminated April 30 next year. In effect, the renewed DP Act keeps the framework for controls law, but limits the extent and scope, especially in controversial price controls.

Due to appropriations cutbacks by Congress, defense agencies are dismissing personnel to meet new budgets. NPA layoffs by September 26 will total 800, by year-end 1800 (about 35% of total employees). DPA will lose 80 employees by Labor Day, and OPS layoffs will be substantial.

Certain major electrical equipment items (switchgear, circuit breakers, switches, transformers, etc.) will not be rescheduled for delivery by NPA except in cases of defense emergencies. NPA outlined details for guidance of claimant agencies, manufacturers and purchasers in Direction 1 to Order M-44, issued July 7, 1952, and listed normal lead times for these electrical products.

NPA's lighting equipment Order M-97 was revoked in mid-July which prohibited the use of copper except for current-carrying parts. Also under consideration for revocation is Order M-47A which now restricts use of brass, copper and copper base alloys for consumers goods and for decorative purposes.

# TIREX IS A FAMILY



To a great many people the name "TIREX" means a small, flexible, long-wearing portable cord. Actually, TIREX is the name of a family of portable cords and cables. The family ranges in size from a single conductor  $\pm 18$  cord, all the way up to a 3-conductor Type SH-D cable for voltages in excess of 10,000 V.W.P.

TIREX cords are made in sizes from 18 to 10, from single to eight conductors in Type SO, and from two to four conductors in Type SJO. There are TIREX Mine Cords, as well as heavy duty shielded cords.

In the cable field there are single and multi-conductor cables, shielded or unshielded, Types W or G, SH-A, SH-B, SH-C and SH-D.

Your local distributor has many of the TIREX cords and some of the TIREX cables in stock. He can get most of the other stock type TIREX cords and cables for you in a comparatively short time. Be sure to see your local distributor whenever you need portable cords and cables.

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# AUGUST . . . . at a Glance

### Neutral Current

The many questions that come to us for "Questions on the Code" and "Reader's Quiz" as well as the inquiries to the editors on Reader Service cards often disclose common problems by the frequency of inquiries about a particular subject. They point to the need for a good practical article. The frequency of questions relating to neutral current on 3 phase 4 wire systems aroused the interest of B. A. McDonald of Rochester. We ought to publish, he suggested, a good practical article on how to compute neutral current. Why not, we suggested right back, an article written by B. A. McDonald who, for more than a quarter of a century has been counseling electrical men in the solution of just such problems. "Computing the Neutral Load" page 49, is the result. B. A. McDonald's initials have given authority to many discussions in "Questions on the Code" over the past few years.

### High Frequency Carriers

Carrier current signals in the 3000 to 6000 cycle range superimposed on the wiring system for lighting is used for a new electric clock correcting and synchronizing system. The method is also adaptable to other signalling and communication services and we can expect to see many developments employing carrier signals in the future. Some types of power factor correction in fluorescent ballasts offer virtually a short circuit to such carrier signals. An analysis of the problems encountered and recommended solutions is given in Glenn Walters'

"High Frequency Problems in Lighting Circuits" beginning on page 56.

### Pace Setting Wiring

Suburbanite Los Angeles shoppers are swarming to a swank new department store which is outstanding because of a country-club appearance and setting and an unusually complete assortment of merchandise and service facilities. It is also outstanding due to dramatic lighting, load center substations, air conditioning, public address facilities, remote control of motors and materials-handling provisions. Wired by Electrical Contractor William Simpson of Beverly Hills and inspected last month by Industrial Editor Hugh Scott, this pace-setting store is discussed under the title of "Modern Electrical Facilities Complement Modern Design" on page 52.

### Gas Alarm System

Constant protection against dangerous concentrations of highly flammable vapors in the Swift Soybean plant, Champaign, Ill., is provided by an extensive gas alarm system. The details of the operation and electrical circuitry of this system are presented along with a description of the system equipment in "Gas Alarm System-Electrical Watchdog," on page 58. Included with the text is a complete wiring diagram, showing the related power supply circuits, the disposition of alarm stations and controls and the vast interconnecting signal network throughout the plant.

### DATES AHEAD

- Illuminating Engineering Society— National Technical Conference, Edgewater Beach Hotel, Chicago, Ill., September 8-13.
- International Association of Electrical Inspectors — Northwestern Section, Twin Falls, Idaho, September 11-13; Southwestern Section, California Hotel, Fresno, Calif., September 18-20; Eastern Section, Hotel Statler, Washington, D. C., October 2-4; Western Section, Hotel Hollenden, Cleveland, Ohio, October 6-8; Southern Section, Hermitage Hotel, Nashville, Tenn., October 13-15.
- National Electronics Conference— 8th annual conference. Sherman Hotel, Chicago, Ill., September 29-Oct. 1.
- Canadian Electrical Manufacturers Assn.—8th annual meeting, Gen-

- eral Brock Hotel, Niagara Falls, Ontario, Canada, October 1-3.
- International Association of Electrical Leagues—17th annual conference, Radisson Hotel, Minneapolis, Minn., October 1-4.
- National Electrical Contractors Association Annual convention, Hotel Morrison, Chicago, Ill., October 5-10.
- Electrical Industries Show—Sponsored by the Eastern Electrical Wholesalers Association, 165th Regiment Armory, New York, N. Y., October 14-17.
- National Farm Electrification Conference—Hotel Statler, Detroit, Mich., October 20-21.
- National Industrial Service Association—Southeastern Chapter meeting, Miami, Fla., Oct. 24 and 25.

- National Electrical Manufacturers Association—Haddon Hall Hotel, Atlantic City, N. J., Nov. 10-13.
- American Institute of Electrical Engineers—Winter general meeting, New York, N. Y., January 10.22
- Plant Maintenance Show Public Auditorium, Cleveland, Ohio, January 19-22.
- National Electrical Manufacturers Assn.—Edgewater Beach Hotel, Chicago, Ill., March 9-12.
- Industrial Electrical Exposition— Sponsored by Essex Electrical League, Terrace Room, Newark, N. J., March 10-13.
- Edison Electric Institute—Annual sales conference, Edgewater Beach Hotel, Chicago, Ill., March 30-April 2.



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### **Tamper-proof Wiring**

**SOMETIMES WE WONDER** if electricity is here to stay. A look at many wiring materials and methods would lead the casual observer to suspect that facilities for hasty removal with simple tools was an important consideration in the design and installation of wiring systems and equipment. In our technical wisdom we know better. But the fact remains that practically all "permanent" wiring not firmly imbedded in masonry can be readily disassembled with primitive tools.

**GROWING ELECTRICAL ULITIZATION** is bringing larger capacities and more elaborate circuitry to even the small home. Industrial installations are frequently a complex of different systems and voltages. But the vital barriers and enclosures which insure safety and reliability can be readily disabled by the most indifferent mechanic.

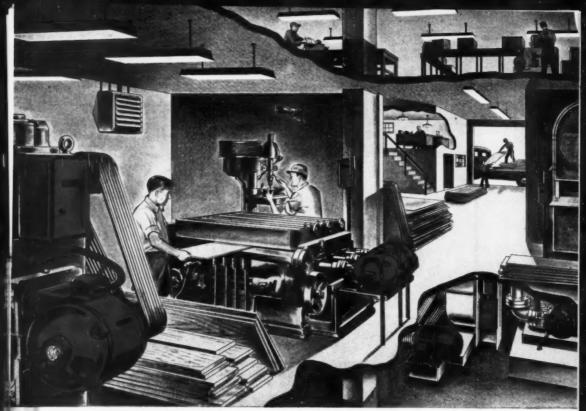
NO ONE BUT A SKILLED ELECTRICIAN has right or reason to modify the parts or components of a wiring system. There is no call for easy access. On the contrary, special skills or tools should be required as a basic precaution for the protection of the public.

ACCESS FOR NORMAL REPLACEMENT, as for fuses or lamps, is essential and should be easy and convenient. Access for maintenance and replacement of wearing parts, as in motor controllers, should also be convenient, but limited by design to the specialized keys or tools of authorized personnel. Beyond these essentials the trend of design must be set toward the tamper-proof wiring system.

**EASE OF INSTALLATION** is an important characteristic of design. The significant "cost" of any product or method is the **installed** cost. Practically all materials and components of wiring systems are installed by skilled mechanics. The labor component of installed cost is **skilled** labor. The nuts and bolts, the screwdriver assemblies created in the name of "easy installation" are too often feeble compromises between product design and installation skill using neither to advantage.

MOST WIRING IS PERMANENT. With the exception of industrial systems designed for frequent modification, it remains in use until it is obsolete or abandoned. The salvage value of its parts is insignificant. It can and should be a one way job, sealed and inaccessible to anyone but a skilled mechanic equipped with specialized tools.

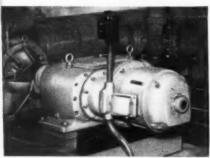
Um. V. Stuart



POWER — WHEN AND WHERE IT'S NEEDED. Smooth, steady power for any production line begins when you install Graybar-distributed G-E motors and controls. AC or DC... general- or special-purpose, G-E Tri-Clad motors offer your

customers extra protection against physical damage, electrical breakdown, and operating wear. Given ordinary care, you can count on G-E motors for dependable service under even the toughest operating conditions.

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General Electric Tri-Clad motors and matching G-E controls make a hard-to-beat production team. Your customers get reliable, uninterrupted performance shift-after-shift-a practical defense against downtime due to motor failure.

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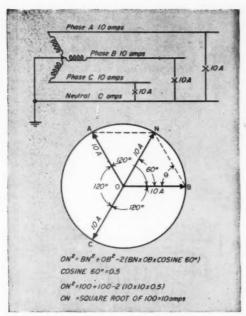


FIG. 1—Three phases in use-balanced loads.

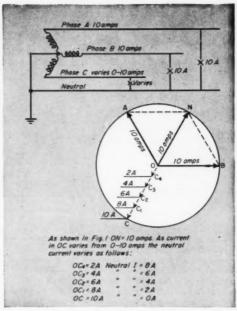


FIG. 2-Two phases in use-balanced loads.

# Computing The Neutral Load

## In Three-Phase, Four-Wire Grounded Wye Systems

How to use vector diagrams and simple math in calculating the neutral current in 3-phase, 4-wire systems with balanced and unbalanced loading.

By B. A. McDonald, New York Board of Fire Underwriters, Rochester

INDING the current in the neutral of 3-phase, 4-wire, wye connected systems involves a two-step procedure: 1. Construct a vector diagram; 2. Solve for the resultant of this diagram. This procedure applies for the neutral current in all such 3-phase systems, with either two or three phases in use and with balanced or unbalanced loading on the systems.

Basically, the phase relationship between currents in a 3-phase, 4-wire system is the key to the vector analysis. The currents in the phase wires of any three-phase system are alternating with a phase displacement of 120 degrees between any one current and the other two. These currents can, therefore, be represented as three vectors with a common origin and with equiangular displacement between them. With the vector lengths representing the current values to some scale, the resultant of the vector diagram will represent the neutral current to the same scale.

To solve for the resultant of any three-vector diagram:

1. Complete a parallelogram on any two of the vectors—from the end opposite the origin on one of the vectors, draw a line equal in length and parallel to the second vector; from the end opposite the origin on the second vector, draw a line equal in length and parallel to the first vector.

The diagonal of this parallelogram, from the common origin of the vectors, is the resultant of the two vectors.

Complete a second parallelogram using the remaining vector and the resultant of the other vectors.

The resultant of this second parallelogram is the resultant of the three vectors.

Vector analysis of the current values in three-phase systems can, with careful attention to the scales used, be car-

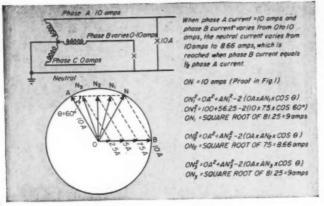


FIG. 3. Two phases in use—unbalanced loads.

ried out to a complete graphical solution. But complete solution by the use of vectors is often cumbersome and subject to inaccuracies. For this reason, vectors are used to best advantage in establishing only a graphical picture of the phase relationships between the scalar quantities. The current values and angles between them are then inserted in some basic trigonometry formulae for quick solution.

In the following discussion, a separate computation of the neutral current is made for each of the several conditions of phases-in-use and loadbalance. In each case, unity power factor is assumed for the loads connected to the phases. To solve for the resultant of three currents operating at different power factors, a more detailed analysis is necessary. In such a case, the basic computations still apply and need only be altered to account for the lead or lag of the currents, remembering that the decimal equivalent of the power factor percent is the cosine of the angle by which the current vector is displaced from its position at unity power factor.

THREE PHASES IN USE, BAL-ANCED LOADS. (Refer to Fig. 1) Phases A, B and C are equally loaded with 10 amperes from each phase conductor to the grounded neutral. In the vector diagram, a parallelogram is completed (dotted lines) on vectors OA and OB. The resultant of these two vectors is ON, which is equal in length to OA and OB. Because OA and OB are scalar quantities representing 10 amperes, the resultant ON must also equal 10 amperes. This is the graphical solution for the value of ON by measuring the vector lengths.

A more accurate solution for the value of ON can be made with the trigonometric formula—

 $ON^2 = BN^2 + OB^2 - 2(BN \times OB \times COSINE \Theta)$ 

Such a solution is made from the known line and angle relationships in the diagram and does not depend upon precise measurements of the vectors.

To determine the value of angle  $\theta$  for use in the above formula, refer to triangle OBN in the vector diagram. Sides OB and BN are equal by construction. The triangle is, therefore, isosceles, and angles BON and ONB are equal base angles of an isosceles triangle. But angle ONB is also equal to angle AON—alternate interior angles of parallel lines. Angle AON, therefore, is equal to angle BON, and their sum is 120 degrees by construction. Each of the three angles in triangle OBN is 60 degrees and angle  $\theta$  is 60 degrees.

Further study of the vector diagram reveals that the 10-ampere resultant ON is in a direction 180 degrees opposed to the direction of the 10-ampere vector OC, representing the current in phase C conductor. From the basic concept of vector analysis, the resultant of diametrically opposed vectors is the difference between their values. In this case, then, the final resultant is 10 minus 10, or zero.

Conclusion from the proof: In a three-phase, four-wire, grounded wye system, the current in the neutral conductor is zero when the currents in the phase conductors are equal.

TWO PHASES IN USE, BAL-ANCED LOADS. (Refer to Fig. 2) Phases A and B are equally loaded with 10 amperes to the grounded neutral. Phase C current is zero. In

the vector diagram for this condition, the current in the neutral conductor is represented by the resultant of the two phase current vectors. From the parallelogram completed on the two vectors, the resultant ON is found, by measurement or equation, to be 10 amperes. For the assumed conditions, therefore, the neutral current is the same as that in each of the phase conductors.

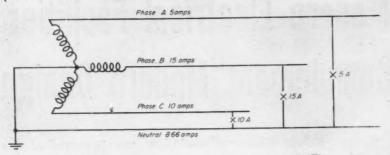
Another condition of neutral current can be developed from the above by gradually adding current from phase C to the neutral. As shown in Fig. 2, when current vectors are added to the diagram to represent phase C current, the differences between these vectors and resultant ON represent neutral current. When phase C current has increased to 10 amperes, the difference between ON and OC is zero. The condition of the system is then the same as it was in Fig. 1, and the neutral current is zero.

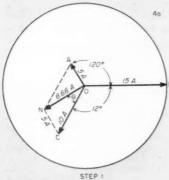
TWO PHASES IN USE, UNBAL-ANCED LOADS. (Refer to Fig. 3) Phase A current is 10 amperes. Phase C current is zero. By varying the current from phase B to the neutral, the neutral current also varies as shown in the diagram. When phase B current equals 10 amperes, the condition of the system is the same as that in Fig. 2, and the neutral current is 10 amperes. When phase B current equals zero, the system is effectively singlephase and the neutral current is again 10 amperes. The minimum neutral current under these conditions is 8.66 amperes, when the current in phase B equals 5 amperes.

THREE PHASES IN USE, UNBALANCED LOADS. (Refer to Fig. 4) Phase A current is 5 amperes; phase B, 15 amperes; and Phase C, 10 amperes. The neutral current in this case is the resultant of the three phase-current vectors. The first step in the solution is to obtain the vector sum of the currents in phases A and C. This is shown as ON in Fig. 4a. Next, the vector sum of resultant ON and vector OB is constructed in the diagram, Fig. 4b. The final resultant, ON, represents the value of the current in the neutral conductor.

The neutral current value for a second proof is shown in Fig. 4c and is the same as that in the first proof.

Although the vectors and mathematics used in this discussion might be considered elementary, a good working familiarity with the type of computations presented in this article is, and always will be, a distinct asset in the design of wiring systems.

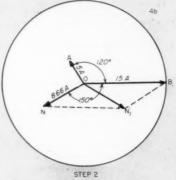




Vector sum of currents in phases A and C.
As shown in Fig 3, when OA is one-half OC, the resultant current ON = 8.66 amps.

By equation:  $ON^2 = OC^2 + OA^2 + 2(OC \times OA \times COS 120^\circ)$ ON = SQUARE ROOT OF 75 = 8.66 amps.

To solve for angle  $\theta$  :  $NC^2$ =0 $C^2$ +0 $N^2$ -2 (0C×0N×C0S  $\theta$ ) 25+100\*7S-2f(0 $\times$ 8.66  $\times$  C0S  $\theta$ ) C0S  $\theta$  = .866 ...  $\theta$  = 30 $\theta$ 



Vector sum of currents in ON and OB = Current in neutral

ON, = 208 + ON P + 2(08 x ON x COS 150°) COS 150° = -COS 30° = -0.86603 ON, = 225 + 75 + 2 [15 x 8.66 x (-866)] ON, = SQUARE ROOT OF 75 = 8.66 amos

Current in neutral = 8.66 amps

### Alternate proof

- ONE : OA 2 + OB 8 + 2 (OA x OB x COS 120 \*)

  ONE : 25 + 225 + 2 [\$ x 15 x (-0.5)]

  ON \* SOUARE ROOT OF 175 = 13.3
- (2) To solve for angle  $\theta$ :  $NB^2 = ON^2 + OB^2 - 2(ONxOBxCOS \theta)$  $COS \theta = 0.94 \theta = 19^\circ$
- (3)  $ON_r^2 = ON^2 + OC^2 + 2(ON * OC * COS | 39^o)$  $ON_r^2 = |75 + |OO + 2 [ |33 * | -COS | 4|^o]]$  $ON_r = SQUARE ROOT OF 75 * 8.66 amps$

Current in neutral = 8.66 amps

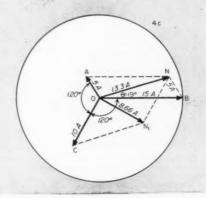


FIG. 4. Three phases in use—unbalanced loads.

# Modern Electrical Facilities Complement Modern Design

Dramatic lighting, load-center substations, remote control of motors, air conditioning, public-address facilities and other special electrical services promote convenience, comfort and sales in this California department store wired by contractor William Simpson.

By Hugh P. Scott

Robinson's Beverly—progressive, recently-completed department store catering to needs and whims of suburbanite Los Angeleans—dramatically emphasizes the value of modern lighting, air conditioning and special electrical services for promoting customer comfort, shopping convenience and display effectiveness. Considerably removed from the city's traffic-

jammed building-crowded center, this new merchandising mart has ample acreage for attractive landscaping, glamorized by after-dark floodlighting; uncramped parking, with attendant-paging communication provisions, and a sunken garden wired for musical transcription, coloramic illumination and incidental power requirements. Within the structure itself, electrically-

served sales areas are spaciously eveappealing, lighting is decoratively functional, electric cooling and heating insure tempered air distribution, and transportation facilities include moving stairways and elevators for customers, belt and overhead conveyors for merchandise. The electrical installation-comprehensive, well designed and equally well executed-was by electrical contractor William Simpson of Beverly Hills. Planning was by electrical engineer C. E. Mauk and architects Pereira-Luckman & Charles Matcham. Lighting fixtures, manufactured by Century Lighting, were originated by industrial designer Ravmond Loewy, who also planned the eye-appealing decorative motifs

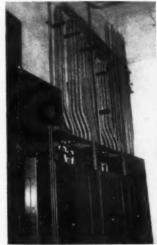
Primary service is at 16.5-kv 3-phase from an underground network of the Southern California Edison Company, with conversion to the 480-volt distribution level effected by a vault-enclosed 2500-kva transformer. Power at 480-volts is carried through the store to secondary load centers and to power panels controlling refrigeration machines, elevator and escalator motors, air conditioning and boiler room equipment, sump pumps, woodworking shop apparatus and other heavy motor-operated devices.

Six strategically-located load-center substations convert this power further to 120/208-volt 4-wire service for lighting and receptacles in the sales, garden, restaurant, service and parking areas. Then, to serve perimeter lights, a single-phase, 15-kw 6.6-amp constant-current unit is provided.

Air conditioning, boiler room and



LOAD CENTER SUBSTATIONS in basement (foreground) step 480-volt current to lighting and receptacle utilization level of 120/208; serve switchboards on upper floors through 1350-amp vertical busduct risers.



AMPLE WIRING TROUGHS facilitate connection of branch circuits to phase and neutral buses in breaker panels. Neatly racked conduits are characterized by sweep bends rather than by ells at change-of-direction points.



ADVANCED DESIGN—electrical, architectural and structural —makes this Beverly Hills store a pacemaker in the field of modern merchandising. Ample parking facilities and two entrance levels appeal to suburban motor-shoppers.



BROAD, CLEAN CEILING of main floor is illuminated by pattern of recessed square-lens fixtures. Decorative chandeliers of crystal, brass and frosted glass contribute to informal yet swank atmosphere.



**HUNTING HORNS** designed into unique wall luminaires, an abundance of both general and local illumination, coffers and cove variations, together with the liberal use of bold colors and leather furniture win masculine approval.



**CUT CRYSTAL CHANDELIERS** and wall sconces, cove-lighted ceiling and fully electrified stage for fashion presentations are features of salon areas devoted to feminine gowns and accessories.

refrigeration equipments are operated by relays and remote controls located in the engineer's office, also by thermostats and similar automatic control devices. All heavy duty receptacles are 2-gang, with pilot lights incorporated in all plug-in stations.

#### Distribution Mediums

Low-reactance bus duct is used between the 16-kv/480-volt primary transformer and the main switch-board's electrically-operated 4000-amp circuit breaker, also between three of the basement-based 500-kva 480/120-/208-volt substations and lighting panels located on the garden-, first-and second-floor levels. Both horizontal and vertical bus duct runs are of indoor ventilated construction with har cross-sections sized in accordance with a current-carrying factor of 1000 amps per sq. inch, and with buse amply supported and braced to

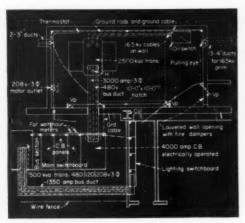
withstand all normally-anticipated mechanical or short-circuit strains.

Distribution between transformers and panels is also by cable carried in both rigid conduit and square metal wireways, while branch circuiting is via conduit, thin-wall tubing with compression type couplings (in furred ceilings) and armored cable (for flexible motor-connections).

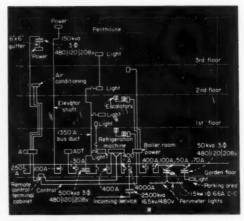
All conduit and raceways, together with neutral conductors, cabinets, boxes, fixtures, motor frames and all control housings are grounded to the cold water system with ground wires running continuously through panels, pull-, outlet- and junction-boxes.

Wire and cables are standard 600volt construction; types R, TW and RU used generally in dry locations, type SB in hot locations such as over kitchen ranges, and waterproof grades such as RW, TW or neoprene in damp locations and underground. Changes of direction in conduit runs carrying wires larger than No. 8 are effected via sweep bends; no factory ells being used under these conditions. Conduit joints in all floor slabs are made up with red lead and bituminous paint, while conduits placed underground are further protected by black felt paper sandwiched between two coatings of asphaltic paint, or by a 3-inch concrete sheath. Underground conduits, after being thus made up and treated, were checked for leaks by means of sustained air pressure tests.

Lighting panels on the lower or garden floor are located closely adjacent to the 480/120/208-volt transformers, while panels on upper floors are located directly above these units so that all lighting switchboards may be served by the 1350-amp bus ducts that rise vertically through the building from these substations. Lighting panel enclosures are floor-mounted,



COMPACT ARRANGEMENT of primary 16kw/480-volt transformer, main switchboard, one of the 500-kva 480/120/2020 volt step-down units and this local lighting switchboard permits short runs of low-reactance busduct, minimizes voltage drop and concentrates equipment in small area for rapid inspection and maintenance.



ABBREVIATED RISER DIAGRAM suggests scope of distribution by including typical substations, a constant-current transformer for series lighting circuits, remote control arrangements, 480-volt service to heavy motorized equipment, square nutter wireways and vertical busduct risers to upper-floor lighting ponels.

with the line side of each group of panels completely bussed for 120/208-volt 3-phase 4-wire service. Neutrals are solid, tapped and fitted with binding screws for the ground legs of all branch circuits extending from the panels. Wiring gutters extend completely around each panel to permit maximum wiring freedom. Gutters are generally 6 inches or more in width; never less than 4.

Power panels are equipped with circuit breakers of the thermal, inverse-time-limit De-ion type with trips for full load current on the corresponding motors. In many cases combination circuit breakers and motor starters are used, with starters of bi-metal thermal-overload quick-make-break construction. Start-stop stations, when required, are equipped with flush-type pilot lights.

### Decorative, Functional Lighting

Lighting is uniformly excellent, designed to harmonize with the overall themes of various store areas. For example: to promote an initial impression of expanse, warmth and richness on the main floor, the broad ceiling is kept free of all suspended units with the exception of three modern chandeliers composed of 18-inch spheres studded with transparent crystal balls that produce interesting highlights. From these spheres, spreading polished brass arms sweep outwards, tipped by modern hourglass-shaped luminaires of brass and frosted glass. The ceiling

proper is illuminated by a pattern of recessed square-lens fixtures housing both incandescent and fluorescent lamps to obtain proper color balance. In-built display-case lighting and ceiling-recessed swivel-spots effectively illuminate both case-contained and free-standing merchandise. Color, also, is used to carry the predominant warmth of southern California into the store, with the main floor motif combining off-white, gold, bronze, burnt-sand carpeting and soft-pink marble.

Departments catering to male shoppers, constituting nearly a fourth of the store's total selling area, have masculine appeal due largely to clean fixture-free ceilings, general highlevel illumination obtained from recessed lensed or louvered units, coves and coffers for variation, unique ornamental wall luminaires (such as crossed black-horn gold-mounted hunting horns) and an abundance of local lighting for the critical examination of cloth and accessories. The use of bold colors, leather furniture, sporting prints and unusual fiber wall panels also add to this male environment.

Areas devoted to the sale of women's gowns also utilize central cove-lighted ceiling panels and recessed downlights for accent, yet they create a feminine touch through the additional use of cut crystal chandeliers and wall sconces constructed on black metal work and backed by pastel walls, pale pink ceilings and light wall-to-wall carpeting. For fashion shows and other presenta-

tions, one of the gown salons is equipped with a stage complete with dimmer-controlled lighting, color-blending equipment, motor-drawn curtains, outlets for voice or musical reproduction equipment and the like. Here the decorative color motif is white, gold and silver.

Other areas in the store are likewise designed to conform with the function of space, type of displayed merchandise or customer characteristics. Following this approach, lighting includes a wide variety of incandescent and fluorescent fixtures, lenses and louvers, conventional and inverse ceiling coves, control arrangements and color combinations. Glare and eye fatigue are minimized, and color balance is obtained by blending the incandescent predominance of reds and vellows with the blue-green-violet qualities of fluorescent lighting. For special displays and decorative effects lighting includes numerous local applications of recessed spots, downlights and coves. Yet lighting is fairly standard through most of the sales, administrative and special areas to simplify maintenance routines and minimize the inventory of replacement items.

Functional floor planning, yearround air conditioning and complete audio facilities are additional features holding the attention of Robinson's Beverly shoppers, and this modern department store may well influence future progress in the development of suburban mechandising centers.

### ESTIMATING FORUM

### Pull Box Labor Units—What they Include

By Ray Ashley

Research and Consulting Engineer Chicago, Illinois

QUESTION: In preparing labor units for pull and junction boxes, what labor operations must be allowed for?

- ANSWER: 1. Study time and ordering.
  - 2. Receiving and delivering to storage space.
  - 3. Moving from storage space to point of installation.
  - 4. Establishing location (layout).
  - 5. Installing in place.\*
  - 6. Conduit nipples-measuring, making, and installing.\*\*
  - 7. Increased cost of installing cable.\*\*

DISCUSSION: Items 1 to 5 are included in the standard base labor unit. For estimating purposes the base unit is augmented by additions designed to cover the time required for conduit nipples and the extra labor for pulling cable.

There has been much talk about pipe entrances and estimators sometimes get confused and figure nipples for each pipe entering or leaving the box. There are two pipe entrances for each conduit entering and leaving the box, but only one nipple chargeable to the particular box. Conditions permitting, the box can be placed so that it comes at the ends of standard conduit lengths and no nipples will be required.

Boxes can often be designed so that cutting nipples will be eliminated. For example: take a riser requiring a 12" x 15" x 4" splice box on each floor. With floor to floor dimensions of 11'-6" there would be a 3-in, nipple required at each box. By using 12" x 18" x 4"

boxes, the space between them would be reduced so that the standard length of conduit would reach and the nipples would be eliminated.

For general estimating purposes it is good practice to figure one nipple for each conduit run. The labor unit for the nipple includes measuring, cutting, threading, and installing. The second pipe entrance is cancelled out by the labor that is saved by not connecting to another length of conduit.

The time required for installing an 18" x 24" x 4" ceiling pull box, with one 2-in, and two 3-in, conduits entering and leaving in a straight line, would be figured as follows:

Install Box-Base Unit (see note 1) ........3.0 hrs. 1-2-in. Nipple at 0.5 hrs. (see note 2) ..........0.5 hrs. 2-3-in. Nipples at 0.75 hrs. (see note 2) ......1.5 hrs.

> 5.0 hrs. Total

### Notes:

- 1. For box installation units see "Electrical Estimating"-Page 66, McGraw-Hill Book Co.
- 2. For conduit Nipples see "Electrical Estimating"-"Conduit Terminals"-Page 67.
- 3. Further pull box studies see "Electrical Estimating"-Page 60.
- It is difficult for the beginner and, we might well add, for many experienced estimators, to appreciate the time consumed by pull and junction box installations. It is not only the time actually spent on the box installation that counts up, but the interruption to the work of running a continuous line of pipe, is costly.

Cable taps and splices in junction boxes are figured as a separate item. The effects of pull boxes on the cost of wire pulling, justify considerable discussion and will be treated in another article, Similar treatment will be given to duplicate and parallel cable runs.

<sup>\*</sup>Fastening and Hangers are figured as separate items.

<sup>\*\*</sup>Items must be established for the particular job.

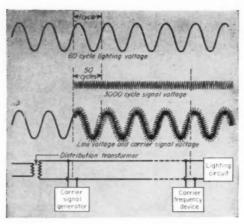


FIG. 1—Carrier current high frequency signal systems operating at 3000 to 6000 cycles per second may be superimposed on normal 60 cycle lighting circuits.

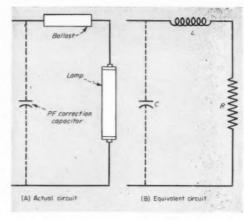


FIG. 2—Lamp-ballast circuit for a fluorescent lamp in simple form is an inductor and resistor series connected and shunted across a lighting circuit.

# **High Frequency Problems**

Carrier current systems superimposed on lighting circuits require high circuit impedance and fluorescent lighting components with high frequency characteristics for best performance.

### By Glenn Walters, Design Engineer

Specialty Transformer and Ballast Department General Electric Company, Fort Wayne, Indiana

ood performance of a carrier current system requires the proper fluorescent lighting components. Hence, in planning fluorescent lighting installation where a carrier current system may be used, components must be selected so that the characteristics of the lighting circuit will not adversely affect the carrier current system.

A carrier current system superimposes a high frequency signal onto alternating current lighting circuits. This signal actuates and controls some special device. Thus, no special wiring is needed for the carrier current device and a number of devices can be controlled from a central point. The principle of combining the carrier signal with the alternating current line voltage is illustrated in Fig. 1.

A typical application of carrier current is a clock system wherein clocks throughout a building are corrected and synchronized by carrier signals

in the 3000 to 6000 cycles per second frequency range over the normal lighting system circuits.

### Circuit Impedance

The reaction of a lighting circuit to the superimposed high frequency signal determines to some extent how well a carrier system will perform. Specifically, if the circuit input impedance to the carrier signal is too low, the lamp circuit in effect short circuits the signal. As a result the carrier voltage may drop below the minimum required to operate the clock or other device.

In a fluorescent lamp circuit the high-frequency input impedance is determined principally by the ballast. For example, the simplest ballast-lamp circuit is practically equivalent to an inductor and a resistor connected in series and shunted across the line (Fig. 2). The resistance is approximately constant over a wide range of

frequencies. The reactance of the inductor, being equal to  $2\pi f L$ , increases at the higher frequencies. Hence, the impedance of the series combination is considerably greater at the carrier frequencies than at power frequency.

The simple ballast-lamp circuit shown in Fig. 2 operates at low power factor. Power factor correction also affects the operation of carrier current systems. To counteract the lagging current drawn by the inductor, and hence to improve the power factor of the Fig. 2 circuit, a capacitor may be shunted across the line input terminals. The reactance, and hence the impedance, of the capacitor is equal to ½πfC and decreases at the higher frequencies. Thus at the carrier frequency the corrected circuit has low input impedance. In fact, the impedance is determined primarily by the capacitance necessary to correct power factor and may be extremely low.

Power factor correction may also be

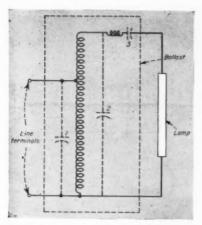


FIG. 3—Power factor correction on a single-lamp ballast circuit may be effected at any one of three positions. No. 3 is desirable for signals.

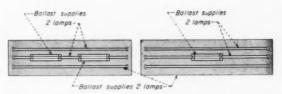


FIG. 4—3-lamp luminaires should be operated from three 2-lamp highpower-factor ballasts with the third lamp in each fixture connected to one ballast for minimum interference to carrier current systems.

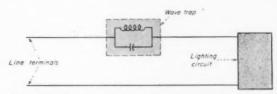


FIG. 5—Wave traps may be used to isolate carrier current signals from normal 60 cycle lighting circuits. Wave trap consists of inductor having high impedance and capacitor connected in parallel.

# in Lighting Circuits

accomplished in other ways (Fig. 3). From the standpoint of high-frequency input impedance a shunt capacitor directly across the line (position 1), or across the secondary of the autotransformer (position 2) is undesirable. A capacitor in series with the lamp (position 3) is not objectionable.

### Choice of Ballasts

Generally, any high-power-factor ballast ii. which a capacitor is shunted across the line terminals or across parts of the windings may adversely affect the performance of an associated carrier current system. Some single-lamp and three-lamp ballasts are constructed with shunt capacitors and their use should be avoided in installations where carrier currents are being considered.

Most two-lamp high-power-factor ballasts, however, have a series capacitor (Fig. 3, position 3). Their use is recommended for installations in which the use of high-power-factor single- or three-lamp ballasts would be undesirable for carrier current use.

For fluorescent lighting installations having single-lamp fixtures, a two-lamp ballast can be assembled in alternate fixtures with crossover leads between fixtures. Thus one ballast will supply two single-lamp units.

For fluorescent lighting installations

having three-lamp fixtures, two twolamp ballasts can be assembled in every other fixture, with one two-lamp ballast in the alternate fixtures. The third lamp in the alternate fixtures can be supplied by cross-over leads from one of the two ballasts (Fig. 4).

When it is impossible to use crossover wires, one lead-lag two-lamp ballast may be used in each single-lamp fixture, using the lead branch wire and leaving the lag circuit idle. In the case of three-lamp fixtures, two ballasts may be assembled in each fixture, using only the lead circuit of one ballast for the third lamp.

### **Alternative Solutions**

Where an existing lighting installation having high-power-factor "low impedance" ballasts must accommodate a new carrier current system, a solution of the problem is to install wave traps between the line and the lamp circuits.

A simple form of wave trap consists of an inductor and a capacitor connected in parallel (Fig. 5). The inductance and capacitance are selected so that the parallel combination has very low impedance at power frequency and very high impedance at a carrier frequency. Thus the wave trap prevents the carrier signal from reaching the ballast.

One wave trap, installed at the proper point, might serve for a number of lighting circuits. Wave traps that would be suitable for this application are not known to be on the market. However, it should be possible to interest some manufacturer in supplying a suitable design. Or, one might simply specify it in the contract.

It has also been suggested that rotating machinery be used to correct power factor of lighting installations. A synchronous motor, although supplying leading current at line frequency, presents a relatively high impedance at the carrier frequencies. Rotating machinery would generally be ruled out because of initial cost, maintenance, and inconvenience.

Industry groups in Europe have adopted specifications on lamp ballast impedance at audio (i. e., carrier) frequency, in connection with high frequency problems. These specifications specify a minimum input impedance which any type of ballast should have.

Such restrictions place an unnecessary burden on ballast design, since "low impedance" ballasts are acceptable for many installations and may be more economical in many instances. Hence, it is not believed that similar ballast design limitation specifications should be adopted in this country.

# Gas Alarm System— Electrical "Watchdog"

Operation and electrical circuitry of a combustible-vapor alarm system which guards against dangerous concentrations of flammable vapors in a soybean processing plant.

an extensive electrical design, a combustible-vapor alarm system is on constant guard against heavy accumulations of hexane vapor at the soybean solvent extraction plant of Swift and Company, Champaign, Illinois. Hexane, a combustible solvent, is used at this plant to extract the valuable oil from soybeans. Because the hexane vapors might escape into the plant atmosphere at many points in the processing sequence, the alarm system consists of vapor detectors strategically located throughout the plant, a main control board and an auxiliary signal board with indicating lights for each of the detector stations, a power supply circuit with a troublesignal bell, and two alarm-signal horns.

The point of origin for any alarm signal is one of the 12 vapor detector stations. Each detector is an explosionproof, combustible-gas analyzer, operating on 110-volt, 60-cycles, singlephase ac. At each station, samples of the surrounding atmosphere are vacuum drawn into the analyzer and passed over one of two heated, sensitized platinum filaments. The second filament is tightly sealed in an atmosphere of uncontaminated air and is a compensator for the exposed filament in a balanced-circuit arrangement. Both of the filaments are of rugged construction to extremely close tolerances, affording a high degree of sensitivity for accurate measurement of flammable vapors. When the air samples are drawn through the unit. combustibles present in the air make contact with the heated detector filament and are burned instantly. The resultant temperature increase in the filament increases its electrical resistance. Because the sealed compensator filament is unaffected, the balanced-circuit is upset in direct proportion to the combustible content of the air sample. At the point of dangerous vapor concentration, the electrical unbalance is sufficient to close a relay which energizes the alarm.

### Signal Circuiting

Alarm signal impulses which originate at any of the 12 detector stations are transmitted to two alarm-signal panels: a master control panel, on an upper floor of the plant; and an auxiliary panelboard on the first floor. Twelve sets of red and green signal lights are located on both panels. Each set of lights is electrically connected to one of the 12 detectors and indicates visually the condition of vapor concentration at the detector location. Each of the panels is also equipped with a signal horn which sounds an alarm when heavy vapors are detected.

At the main and auxiliary panel, the green signal light in each set indicates that the corresponding detector is operating properly and that the atmosphere at the sampling point is free of a dangerous concentration of the hexane vapor. When a signal impulse is transmitted from one of the detectors, the green light corresponding to that detector goes out; the companion red light comes on; and the horn sounds the warning. Should any detector unit go out of service, its green light will go out without energizing the red light or the horn.

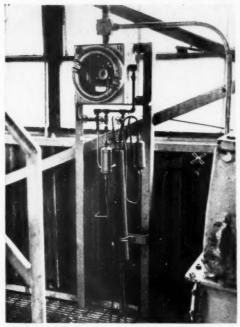
The power supply for the entire alarm system is 110-volt, 60-cycle, feeding three circuits through protective circuit breaker switches. Two of the power supply circuits feed the two turbo compressors which provide

the suction for air-sampling at the detector units; the other feeds the alarm system proper—the balanced-circuit and relay arrangement in each detector, and the associated signal lights and horns.

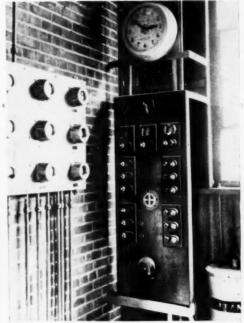
A continuous check on the proper functioning of the power circuits is provided by three sets of signal lights and a trouble-signal bell, all on the main control panel. A green light is connected across the 110-volt supply to each of the three power circuits and indicates, when lighted, that the corresponding circuit is energized and operating properly. If any one of these power circuits is de-energized for any reason, the green light for that circuit goes out and a relay in the circuit cutsin the companion red light and energizes the trouble-signal bell.

Wiring for this extensive alarm network was made in conduit, as indicated in the wiring diagram. Each of the outlying detector stations had to be tied-in to the two panelboards. The scope of the wiring job is obvious from the many widely spaced detector stations which are located as near as possible to those process stages at which heavy concentrations of vapor might escape. In the extraction building, six of the detector stations are on the first floor; one, on the second floor; and two on the fifth floor. No. 10 detector is located on the bridge between the extraction and preparation buildings; No. 11, near the conveyor between the buildings; and No. 12, at the processing filters in the extraction

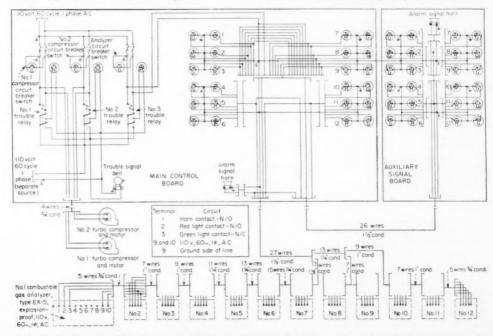
The equipment used in the alarm system at this plant was developed by Mine Safety Appliances Company, Pittsburgh, Pa.



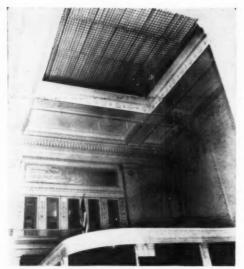
VAPOR DETECTOR is one of twelve such units located throughout the Swift plant to continually sample the atmosphere for combustible content; initiates an alarm signal when hexane vapor concentration becomes dangerous.



MASTER PANEL for the combustible-vapor alarm system contains signal lights for each of the detector stations and an alarm horn common to all stations; also has signal lights and trouble bell to indicate alarm system power failure.



WIRING DIAGRAM of complete alarm system shows power supply circuits and circuits between detectors and signal boards.



LOUVERALL CEILING, high above the main banking area, presents a lighting spectacle, both in its design and in the visual environment it creates.

# 70 Footcandles from 50 Feet Up

How resourceful engineering marked a milestone in lighting progress with the installation by Beach Electric Company, Newark, N. J., of a slimline-louverall ceiling in New Jersey's largest savings bank.

By J. F. McPartland, Jr.

IGH above the main banking area of the Howard Savings Institution, Newark, N. J., a large louvered expanse of slimline fluorescent lighting today represents a unique achievement in modern lighting design. Although this louverall ceiling is only one part of an extensive modernization project in the bank, it is singularly prominent in that it is the first successful application of fluorescent lighting at so high a mounting height. That the installation is a success is readily evident from an analysis of the design problem and how it was solved.

### The Problem

Prior to the new installation, the main banking area of 50 ft, by 75 ft, was lighted by four hanging chandeliers, a total of 8000 watts incandescent. Another 6400 watts was the lighting total from eight side brackets, and continuous incandescent lighting of 1400 watts was concealed in glass-bottomed troughs above the tellers' wickets. Numerous lamps of all types contributed 1700 watts at the business machines and file cabinets. Including lighting at the patrons' wall desks, the overall lighting for the area totaled 19.6 kw.

Under these original conditions, lighting results were poor in quantity and quality. Throughout the area, glare abounded; and light intensities were low and spotty, varying constantly between a minimum of 2.5 foot-

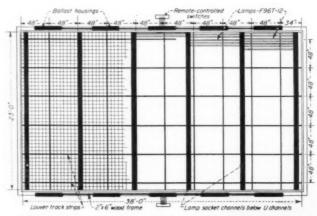
candles and a maximum of 30 foot-candles.

The problem, therefore, was to completely recondition the visual environment in the main banking area. That meant uniformly high level, comfortable light for the varied visual tasks of patrons and employees. The crux of the problem, however, was in the selection of a general lighting system which would adequately complement and enhance the full architectural effect of the 50-foot high interior. Clearly,

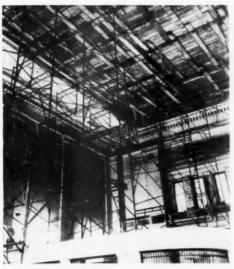
the project demanded skillful design, electrical and constructional.

### The Solution

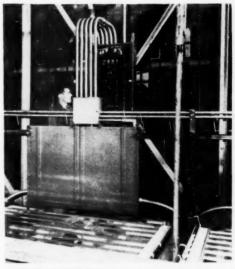
After much study of the problem, it was finally decided that the best results could be obtained from a louvershielded installation of fluorescent lamps in the 23 ft. by 38 ft. ceiling space which was occupied by a stained glass skylight. Behind this decision, however, were months of design calculations by the engineers and architects.



LAYOUT PLAN shows dimensions of louver sections, arrangement of equipment.



**TUBULAR SCAFFOLDING** was erected to provide a working platform 44 feet above the main banking area; allowed regular bank business during installation.



MAGNETIC SWITCHES alongside the louverall area are remote controlled from pushbuttons on ground floor; feed the ballast housings for one side of area.

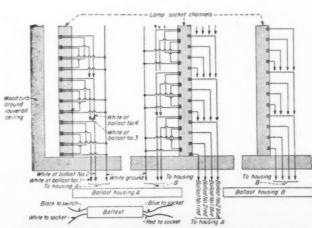
Although the maximum known mounting height of a successful fluorescent installation was only 34 feet at that time, it was established that this 50-foot high interior could be successfully lighted from a ceiling fluorescent system.

The extensive construction work for this installation, however, had to be done with as little interruption as possible to the normal business operations of the bank. For this reason, a 44-foot high scaffold was erected in the interior, effecting a working level from which the louverall ceiling could be constructed. The scaffold was of tubular construction which easily afforded regular traffic and business conditions in the bank.

The first step in the actual installation, after removal of the skylight assembly, was the construction of a framework to support the lighting system. Two 6-inch I beams were positioned over the open space, along the 38-foot length, and were connected to the 6-inch wood curb which forms the perimeter of the rectangular ceiling opening. These I beams were spaced to accommodate connections to 4-inch steel rod hangers with turnbuckles for leveling. The rod hangers are supported at the roof structure and were used with the old skylight assembly. Six 6-inch steel U channels were positioned on 7-foot-6-inch centers, below and perpendicular to the I beams. Each U channel was connected by bolts and angles to the two I beams.

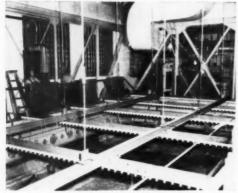
On the steel latticework, the louverall expanse was constructed. A wiring channel with lamp sockets on its under side was mounted along the under side of each U channel. The louver panels were mounted on special aluminum tracks which were installed along the 38-foot dimension and supported by vertical aluminum rods. The top of the louver is exactly 9 inches below the steel U channel. Above the lamps, reflector sections, each of specular alzak aluminum and 4 ft. by 7 ft. in dimension, were mounted between the wiring channels by means of steel hangers which hooked over the sides of the U channels.

A total of 275 F96T-12 slimline lamps (430 ma, 75-watts) were installed in rows of 55 lamps in each of the five bays between the socket wiring channels. By mounting the lamp rows on 7-foot-6-inch centers, the lamp ends for one bay projected 3 inches beyond

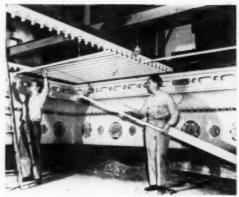


WIRING DIAGRAM of one corner of the louverall ceiling; shows lamp circuits.

### CONSTRUCTION STEPS



Ballast housings were mounted along the long sides of the louverall area.



2 Slimline lamps were installed in each bay on staggered socket arrangement.



3 Louver sections were suspended by track strips on hangers from channels.



4 Reflector sections, 4 ft. by 7 ft., were laid over lamps between channels.

the lamp ends for an adjacent bay. This staggered positioning of the lamp ends at each socket channel eliminated demarcation shadows on the louvers.

The electrical circuitry and controls for the complete system are extensive and flexible. To facilitate maintenance, the lead-lag type ballasts were mounted in ten ballast housings, five along each side of the length of the overall area. Each ballast housing contains 13 twolamp and one single-lamp ballasts and serves one half of a bay. All wiring is color coded. The lamps were installed with a common neutral on each ballast, with circuit and lamp coding to assure quick and easy tracing between ballasts and lamp sockets. Two magnetic switches are located on each side of the louverall area to feed the ballast housings. These four switches are remote controlled from four pushbuttons on the ground floor of the bank and divide the complete lamp area into four sections, with alternately staggered lamp positions. With this control, it is possible to light either the whole or only one-half of each bay.

The louvers used in this installation are of anodized aluminum in cells of 6-in, by 6-in, by 3-in. The sections were installed from the scaffold. Because of their track mounting, visible marks exist on 48-inch centers along the length of the louverall.

### Lighting Results

The visual environment which prevails throughout this bank today is a tribute to sound engineering techniques. In the employees' working area, a uniform level of 70 maintained footcandles now exists. The lighting intensity in the patrons' area is 60

footcandles. And this general high level comfortable light has greatly enriched the architectural interest of the high interior.

Credit for this excellent example of lighting progress must be given to the engineering team which made it possible. Lighting design was by Stanley Beach, the electrical contractor, and John Edelstein and Clyde L. Nordheimer, P. E., both of Gruber Lighting, Inc., Brooklyn, N. V., fixture designers and manufacturers. The architects were John H. and Wilson C. Ely, Newark, N. J. Close cooperation was maintained at all times between these individuals. Without this constant liaison, the task of dovetailing the complex design with the extensive construction would have been impossible. The advantage of integrated engineering is obvious in the results.

# Basic Rules for INDUSTRIAL WIRING DESIGN—2

Second in a series of articles on the design of industrial wiring systems and the selection of wires and cables for industrial applications.

### By Frank Aime

Electrical Engineer Anaconda Wire and Cable Co.

NE of the plagues of any contractor and his principles is power factor. In general it pays to keep it at 90% or better throughout the plant. To show its importance, consider that a circuit carrying a load at 80% power factor must dissipate 56% more loss than when the same load is carried at 100%. Regulation is appreciably poorer at 80%.

The best way to improve power factor is at the load itself; reduces the ampere load on all transformers, breakers, cables and usually saves on the monthly power bill. Every cable helps because of the capacitance of the insulation, but not enough. Other means are:

1. Capacitors on feeders, near a large load or at a low voltage distribution bus. (Can be installed in unit substations or vaults.)

2. Capacitors at a high-voltage bus. (Also can be in cubicles or vaults.)

3. Synchronous motors of the larger ratings instead of induction motors, especially those operated continuously, running at a leading power factor.

Synchronous motors on M. G. sets, running at leading power factor.
 M. G. sets now are being replaced to

some extent by electronic and dryplate rectifiers to obtain de for cranes, hoists, control etc. They are essentially noninductive; do not supply power factor improvement but do raise the circuit average.

Capacitors can be switched in or out automatically by means of a current relay; in when the current on the bus exceeds a predetermined value; out when it falls below.

Table 30 of NE Code, 1951, shows percent reduction in line current by the addition of capacitors to motors of various sizes and speeds.

Tables are available in technical catalogs and literature showing how much kva of capacitors must be added to effect power factor improvement from one value to a higher one.

### System Coordination

System coordination is needed in industrial distribution systems just as well as in big power systems. In California, for one year, records show 85% of electrical injuries occurred on low voltage circuits, 600 volts or less. For minimum expenditure to attain suitable reliability and flexibility, coordinate all breakers all the way back to the

supply. In short, the whole system must be considered as an entity; switchgear integral with transformers, cable and other equipment.

### Circuit Protection Grounded vs Ungrounded Systems

A solidly-grounded-neutral system has a low and usually definite impedance to ground. Transient voltage magnitudes are greatly reduced.

The maximum voltage line-toground is 58% of line-to-line value, the grounded feeder is isolated and usually it is easier to locate the fault and restore service.

When a solid ground occurs on a 3-phase ungrounded system, no breakers are tripped and the potential of the two ungrounded phases is raised to full line-to-line voltage. If maintained, insulation may deteriorate. It is of more importance on circuits above 600-volt rating. This over voltage is a hazard to personnel.

3-phase, 4-wire grounded-neutral systems will clear a fault faster than 3-wire ungrounded systems. One ground fault on an ungrounded system will not take it out and if the system is well maintained, it will hold together

### SIX CARDINAL POINTS FOR CABLE SELECTION

- 1. Installation and Operating Conditions

   The contractor must know them.
- 2. The Best Insulation—Usually there is one preferred insulation for any job; sometimes more than one; a working knowledge of insulation will help decide.
- Practical Limitations A practical knowledge of limitations of cable design and manufacture and ease of installation will prevent pitfalls.
- The Right Covering The covering(s) is just as important as conductor size and insulation, for long life and least trouble.
- Current Rating No one value of currentcarrying capacity can be assigned one size and design of cable. Installation conditions and method of operation must be considered.
- 6. Short-Circuit Heating—Selection of conductor size is dependent upon the allowable temperature rise and varies with the type and voltage.

Description	Maximum Copper Tempera- ture, Deg. C	Recommended Maximum Voltage Rating	Application
UILDING WIRE AND CAL	BLE		
Rubber, Type R	60	600	general purpose power and lighting, minimum quality
Type RH	75	600	general purpose; greater current rating; longer life general purpose; for moist locations
Type RW Type RU	60	600	general use; saves space
Type AC, ACL	00	600	open or concealed wiring, dry locations; Type ACL for weather or continuous
Thermoplastic, Type T	60-105°	600	moisture general purpose; saves space; resists oil, grease, fumes, acids, alkalies;
T - TW	60	600	no braid to deteriorate same as for Type T; for use in moist locations
Type TW Nonmetallic-sheathed	60	600	open or concealed wiring, lighting and power
POWER CABLES, THERMOS	SETTING INSU	JLATION, Abo	ve 600 Volts
Heat-resistant rubber	75	2,000	general purpose, neoprene jacket or with lead sheath and protective jacket
			for moist or flooded or corrosive locations; high reliability, long life
Ozone-resistant rubber	75†	15,000	general purpose, coverings and application same as above
Heat- and ozone-resistant rubber, neoprene-jacketed	75-80°	15,000	general purpose, resists maisture, acids, alkalies, corrosive waters, ais, grease abrasion; high reliability, long life; commonly used for secondaries, dis tribution, high voltage feeders CHECK FOR SHIELDING REQUIREMENTS
POWER CABLES, THERMOI	PLASTIC INS	ULATION	
Vinyl resin	60	500	general power use; high resistance to oils, acids, alkalies; won't burn; toug insulation, no covering
POWER CABLES, VARNISH	ED-CAMBRIC	INSULATION	
1/c and m/c shielded or	85-70‡	28,000	power, lighting and control for high reliability, flexibility, long life; braid of
nonshielded			
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*	85-60\$	69,000	without patheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-valt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheathe and terminated in potheads; minimum overall diameter for a given conductor size; highest dielectric strength; highest permissible conductor temperature maximum efficiency; longest life; most suitable for 11,000-volt circuit.
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*	85-60‡	69,000	power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheods; minimum overall diameter for a given conductor size; highest dielectric strength; highest permissible conductor temperature maximum efficiency; langest life; most suitable for 11,000-volt circuit and higher
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*	85-60‡	69,000	without patheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-valt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conductor size; highest delectric strength; highest permissible conductor temperature maximum efficiency; langest life; most suitable for 11,000-volt circuit.
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*  CONTROL CABLES, THERMO	85-60\$  OPLASTIC, TH	69,000 HERMOSETTING	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-valt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducte size; highest dielectric strength; highest permissible conductor temperature maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  S AND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate
POWER CABLES, PAPER-LE  1/c or m/c shielded ar nonshielded*  CONTROL CABLES, THERMI  Vinyl resin Polyethylene	85-60\$  OPLASTIC, TH	69,000 HERMOSETTING 600 600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducter size; highest dielectric strength; highest permissible conductor temperature maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  5 AND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*  CONTROL CABLES, THERMO	85-60\$  OPLASTIC, TH	69,000 HERMOSETTING	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducts size; highest dielectric strength, highest permissible conductor temperature maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  AND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate land high reliability; braid or lead in dry locations; lead in wet location
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POWER CABLES, PAPER-LE  1/c or m/c shielded ar nonshielded*  CONTROL CABLES, THERM  Vinyl resin  Polyethylene  Varnished-Cambric  Rubber	85-60\$  OPLASTIC, TH  60  80  75	69,000 HERMOSETTING 600 600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducts size; highest dielectric strength, highest permissible conductor temperature maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  S AND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or floam-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate long life, high reliability; braid or lead in dry locations; lead in wellocation.
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*  CONTROL CABLES, THERM  Vinyl resin Polyethylene Varnished-Cambric Rubber  SPECIAL APPLICATIONS	85-60\$  OPLASTIC, TH  60  80  75  75-60§	69,000 HERMOSETTING 600 600 600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conductor size; highest delectric strength, highest permissible conductor temperature maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  5 AND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this servichigh dielectric strength and insulation resistance; no braid to deteriorate (high dielectric strength and insulation resistance; no braid to deteriorate (high dielectric strength and insulation resistance; no braid to deteriorate (high dielectric strength and insulation resistance; on braid to deteriorate (high dielectric strength and insulation resistance; no braid to deteriorate (high dielectric strength and insulation resistance; no braid to deteriorate (high dielectric strength and insulation resistance; no braid to deteriorate (high dielectric strength and insulation, resistance; long life, high reliability
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*  CONTROL CABLES, THERM  Vinyl resin  Polyethylene  Varnished-Cambric  Rubber  SPECIAL APPLICATIONS  Bus-Drop Cable	85-60\$  OPLASTIC, TH  60  80  75  75-60§	69,000 HERMOSETTING 600 600 600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducts size; highest delectric strength; highest permissible conductor temperatur maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  SAND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalias, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service, high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resin or flame-resistant pead in dry locations, lead in well location RN-RW insulation, neoprene jacket or braid in dry locations, neoprene jack or lead sheath in wet locations; excellent heat and moisture resistance; lor life, high reliability
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*  CONTROL CABLES, THERM  Vinyl resin Polyethylene Varnished-Cambric Rubber  SPECIAL APPLICATIONS	85-60\$  OPLASTIC, TH  60  80  75  75-60§	69,000 HERMOSETTING 600 600 600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducts size; highest delectric strength, highest permissible conductor temperature maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  SAND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resist of flame-resistant polyethylene jackes, excellent for this service high dielectric strength and insulation resistance; no braid to deterioral long life, high reliability; braid or lead in dry locations; lead in wel location or lead sheath in wet locations; excellent heat and moisture resistance; lor life, high reliability  3/c or 4/c rubber-insulated cables consisting of 2 or 3 insulated conductor and one uninsulated neutral, braid overall Types SJ and SJO cords; 2/c, 3/c and 4/c with specia, stranding and tour
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*  CONTROL CABLES, THERM  Vinyl resin Polyethylene Varnished-Cambric Rubber  SPECIAL APPLICATIONS  Bus-Drop Cable	85-60\$  OPLASTIC, TH  60  80  75  75-60§	69,000 HERMOSETTING 600 600 600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducts size; highest delectric strength; highest permissible conductor temperatur maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  SAND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service, high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate RH-RW insulation, neoprene jacket or lead in dry locations; lead in wet location RH-RW insulation, neoprene jacket or braid in dry locations, neoprene jack or lead sheath in wet locations; excellent heat and moisture resistance; lor life, high reliability  3/c or 4/c rubber-insulated cables consisting of 2 or 3 insulated canductor and one uninsulated neutral, braid overall  Types SJ and SJO cords; 2/c, 3/c and 4/c with special stranding and tough neoprene jacket for hard service; resists oils, gasoline, greases, impact jacket for hard service; resists oils, gasoline, greases, impact jacket for hard service; resists oils, gasoline, greases, impact jacket for hard service; resists oils, gasoline, greases, impact jacket for hard service; resists oils, gasoline, greases, impact, abrasion; for the production of the pr
POWER CABLES, PAPER-LE  1/c or m/c shielded ar nonshielded*  CONTROL CABLES, THERMI  Vinyl resin  Polyethylene  Varnished-Cambric  Rubber  SPECIAL APPLICATIONS  Bus-Drop Cable  Flexible Cords	85-60\$  OPLASTIC, TP  60  80  75  75-60\$  60  60 (75   1	69,000  HERMOSETTING  600  600  600  600  600  600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducts size; highest dielectric strength; highest permissible conductor temperatur maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  SAND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or floam-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate oilong life, high reliability; braid or lead in dry locations; lead in wel location long life, high reliability; braid or lead in dry locations; neogrene jacket or braid in dry locations, neogrene jacket or braid in dry locations, neogrene jacket or braid in dry locations, neogrene jacket for braid service; resists oils, gasoline, greases, impactobrasion  Types S and SO cords; 2/c, 3/c and 4/c with special stranding and tough neopre jacket for hard service; resists oils, gasoline, greases, impactobrasion  Types S and SO cords; 2/c to 6/c with special stranding and tough neopre jacket for hard service; resists oils, gasoline, greases, impact, abrasion; for the development of the property in the property
POWER CABLES, PAPER-LE  1/c or m/c shielded ar nonshielded*  CONTROL CABLES, THERM  Vinyl resin Polyethylene Varnished-Cambric Rubber  SPECIAL APPLICATIONS  Bus-Drop Cable Flexible Cords  Machine Tool Wire	85-60\$  OPLASTIC, TH  60  80  75  75-60\$	69,000  HERMOSETTING 600 600 600 600 300	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  DIFFE  Dower in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducts temperatur maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  AND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalias, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resin or flame resistance; lost find the proposed of the proposed sheath in wet locations; excellent heat and moisture resistance; for life, high reliability  3/c or 4/c rubber-insulated cables consisting of 2 or 3 insulated conducts and one uninsulated neutral, braid overall  Types SJ and SJO cords; 2/c, 3/c and 4/c with special stranding and tour neoprene jacket for hard service; resists oils, gasoline, greases, impact obrasion; that service is the stranding and tough neoprene jacket for hard service; resists oils, gasoline, greases, impact, abrasion; the hard service; resists oils, gasoline, greases, alkalies, moisture, proposed and proposed and source proposed and source, proposed and source, or sour
POWER CABLES, PAPER-LE  1/c or m/c shielded ar nonshielded*  CONTROL CABLES, THERMI  Vinyl resin  Polyethylene  Varnished-Cambric  Rubber  SPECIAL APPLICATIONS  Bus-Drop Cable  Flexible Cords	85-60\$  OPLASTIC, TP  60  80  75  75-60\$  60  60 (75   1	69,000  HERMOSETTING  600  600  600  600  600  600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conduct size; highest dielectric strength; highest permissible conductor temperatur maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  SAND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or flame-resistant polyethylene; acket, excellent for this service high dielectric strength and insulation resistance; no braid to deterioral long life, high reliability; braid or lead in dry locations; lead in wet location RH-RW insulation, neoprene jacket or braid in dry locations, neoprene jacket or lead sheath in wet locations; excellent heat and moisture resistance; lor life, high reliability  3/c or 4/c rubber-insulated cables consisting of 2 or 3 insulated conducte and one uninsulated neutral, braid overall Types SJ and SJO cords; 2/c, 3/c and 4/c with special stranding and tour neoprene jacket for hard service; resists oils, gasoline, greases, impact, abrasion; heavier service than Types SJ and SJO Vinyl resin, no braid; saves space; resists oil, grease, acids, alkalies, moistur corrosive waters and fumes; long life, high reliability; solid for switchboa
POWER CABLES, PAPER-LE  1/c or m/c shielded ar nonshielded*  CONTROL CABLES, THERM  Vinyl resin Polyethylene Varnished-Cambric Rubber  SPECIAL APPLICATIONS  Bus-Drop Cable Flexible Cords  Machine Tool Wire Control Wire	85-60\$  OPLASTIC, TH  60  80  75  75-60\$  60  60  60  60	69,000  HERMOSETTING  600  600  600  600  600  600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  DIFFE  Dower in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducts temperatur maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  AND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalias, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resin or flame resistance; lost find the proposed of the proposed sheath in wet locations; excellent heat and moisture resistance; for life, high reliability  3/c or 4/c rubber-insulated cables consisting of 2 or 3 insulated conducts and one uninsulated neutral, braid overall  Types SJ and SJO cords; 2/c, 3/c and 4/c with special stranding and tour neoprene jacket for hard service; resists oils, gasoline, greases, impact obrasion; that service is the stranding and tough neoprene jacket for hard service; resists oils, gasoline, greases, impact, abrasion; the hard service; resists oils, gasoline, greases, alkalies, moisture, proposed and proposed and source proposed and source, proposed and source, or sour
POWER CABLES, PAPER-LE  1/c or m/c shielded or nonshielded*  CONTROL CABLES, THERMI  Vinyl resin  Polyethylene  Varnished-Cambric  Rubber  SPECIAL APPLICATIONS  Bus-Drop Cable  Flexible Cords  Machine Tool Wire Control Wire Switchboard Wire	85-60\$  OPLASTIC, TP  60  80  75  75-60\$  60  60 (75   1	69,000  HERMOSETTING  600  600  600  600  600  600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conducts size; highest dielectric strength; highest permissible conductor temperatur maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  SAND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or floam-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate oil ong life, high reliability; braid or lead in dry locations; lead in wel location long life, high reliability; braid or lead in dry locations; neogrene jacket or braid in dry locations, neogrene jacket or braid in dry locations, neogrene jacket, or lead sheath in wet locations; excellent heat and moisture resistance; lor life, high reliability  3/c or 4/c rubber-insulated cables consisting of 2 or 3 insulated conductor and one uninsulated neutral, braid overall Types 5 and 50 cords; 2/c, 3/c and 4/c with special stranding and tour neoprene jacket for hard service; resists oils, gasoline, greases, impact, obrasion  Types S and SO cords; 2/c to 6/c with special stranding and tough neoprene jacket for hard service; resists oils, gasoline, grease, acids, alkalies, moistur corrosive waters and fumes; long life, high reliability; solid for switchboa wire, stranded for control and machine tool wire  Special flexible stranding, combined tough neoprene insulation and jacket Types A, AA and Al for hot, dry locations, for leads to or within apparation of the productions for leads to or within apparation of the productions for leads to or within apparation or within apparation and jacket Types A. AA and Al for hot dry locations, for leads to or within apparatio
POWER CABLES, PAPER-LE  1/c or m/c shielded ar nonshielded*  CONTROL CABLES, THERM  Vinyl resin Polyethylene Varnished-Cambric Rubber  SPECIAL APPLICATIONS  Bus-Drop Cable Flexible Cords  Machine Tool Wire Cantrol Wire Switchboard Wire Arc Welding Cable	85-60\$  OPLASTIC, TH  60  80  75  75-60\$  60  60  60  60	69,000  HERMOSETTING 600 600 600 300 600 600	without potheads up to 7,500 volts; adapted to long vertical runs; suitable for 2,300 to 15,000-volt circuits  Description of the suitable for 2,300 to 15,000-volt circuits  Description of the suitable for a given conductor temperatur maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  AND VARNISHED-CAMBRIC INSULATION  With jacket of same material, excellent for this service; resists moisture, acid alkalias, corrosive waters, oils, etc., no braid to deteriorate with vinyl resist of flower-resistant polyethylene jacket, excellent for this service, high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resist of flome-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resist of flower-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate with vinyl resist of the service of lead in each corrola RH-RW insulation, neoprene jacket or braid in dry locations, lead in wet locations RH-RW insulation, neoprene jacket or braid in dry locations, eagent in the resistance; lor life, high reliability  3/c or 4/c rubber-insulated cables consisting of 2 or 3 insulated conducte and one uninsulated neutral, braid overall  Types SJ and SJO cords; 2/c, 3/c and 4/c with special stranding and tour neoprene jacket for hard service; resists oils, gasoline, greases, impact, abrasion; the envire service than Types SJ and SJO  Vinyl resin, no braid; soves space; resists oil, grease, acids, alkalies, moistur corrosive waters and fumes; long life, high reliability; solid for switchbod wire, stranded for control and machine tool wire  Special flexible stranding, combined tough neoprene insulation and jacket Types A, AA and AI for hot, dry locations, for leads to or within apparation to for general use
POWER CABLES, PAPER-LE  1/c or m/c shielded ar nonshielded*  CONTROL CABLES, THERM  Vinyl resin Polyethylene Varnished-Cambric Rubber  SPECIAL APPLICATIONS  Bus-Drop Cable Flexible Cords  Machine Tool Wire Control Wire Switchboard Wire Arc Welding Cable	85-60\$  OPLASTIC, TH  60  80  75  75-60\$  60  60  60  200-125	69,000  HERMOSETTING 600 600 600 600 600 600 300 600	without potheads up to 7,500 volts; adapted to long vertical runs; suitab for 2,300 to 15,000-volt circuits  LED TYPE  power in moderate and large blocks; highest reliability; must be lead-sheather and terminated in potheads; minimum overall diameter for a given conduct size; highest dielectric strength; highest permissible conductor temperatur maximum efficiency; longest life; most suitable for 11,000-volt circuit and higher  SAND VARNISHED-CAMBRIC INSULATION  with jacket of same material, excellent for this service; resists moisture, acid alkalies, corrosive waters, oils, etc., no braid to deteriorate with vinyl resin or flame-resistant polyethylene jacket, excellent for this service high dielectric strength and insulation resistance; no braid to deteriorate oild for the service high dielectric strength and insulation resistance; no braid to deteriorate oild fifty for the service of the service; resists oils, gasoline, greases, impact obrasion  Types S and SO cords; 2/c, 2/c to 6/c with special stranding and tought neopre jacket for hard service; resists oils, gasoline, greases, impact obrasion. Types S and SO cords; 2/c to 6/c with special stranding and tough neopre jacket for hard service; resists oils, gasoline, grease, acids, alkalies, moistur corrosive waters and fumes; long life, high reliability; solid for switchbook wire, stranded for control and machine tool wire  Special flexible stranding, combined tough neoprene insulation and jacket Types A, AA and Al for hot, dry locations, for leads to or within apparation of the service of the ordinate tool wire of the service of the

<sup>†</sup>Underwriters' specifications

75C for special use only as an appliance cord.

Depending on compound

longer and keep production going longer than a grounded system. Grounds often can be removed during lunch hour. Two grounds will take it out or, in some cases, may overload transformer windings until cleared. Some prefer grounded systems as reasoned above, others ungrounded systems where continuity is important.

### Short Circuits

Cables play a definite part in protection to equipment: their inherent reactance. Three-conductor cable has less reactance per circuit foot than three 1-conductor cables because their spacing between conductors is less. High voltages to ground are produced on a cable system by arcing faults, sometimes by normal switching when one phase is accidentally grounded, as high as 5 to 6 times normal. They can cause insulation breakdown, occasionally at more than one point.

The reactance available for reducing short-circuit values at the point of supply to those, say, at a branch circuit motor, are the feeder cable and the local step-down transformer. Often, there is enough reactance in the cable alone to limit available fault current to a reasonable value at utilization equipment and may be the reactance for local systems escaping a lot of trouble.

When a short circuit occurs, all the power inrush is limited only by the impedance of the circuit or in more reality, for short-time cases, the reactance (ac circuits) to the fault.

Equipment must be protected from heavy mechanical forces created by magnetic stress; they increase as the square of the current. During a short circuit of 20 X normal, forces exerted at all points in the current carrying circuit are 400 X normal.

Means for protecting low voltage circuits beside cable feeders, include:

1. Use of two or more smaller transformer, banks instead of one large

former banks instead of one large bank. 2. Reactors. Their use is limited.

 Circuit breakers operated in lowvoltage circuits by selective tripping or cascading. The former may have higher first cost but may prevent an expensive plant shut down.

4. Fuses. NEC fuses carry no ac interrupting rating. Current-limiting fuses can interrupt currents as high as 100,000 amperes at 250 and 600 volts and are approved by Underwriters' Laboratories, Inc.

5. Solid-grounded neutral: ground faults less expensive and of shorter

In selecting any switchgear, the con-

### HOW CABLE USUALLY IS INSTALLED FOR PRIMARIES AND SECONDARIES

### Insulated, Lead-Covered Cable

### 1. Underground

- a. In fiber- or asbestos-concrete, asbestos, concrete or clay ducts (long runs),
- b. Galvanized conduit, standard or EMT size (short runs),
- c. Occasionally in standard or EMT aluminum or copper alloy conduit (against corrosion),
- d. Metallic-armored, directly buried or submarine

#### 2. Above Ground

- a. Metal conduit, standard or EMT, aluminum or copper allay (against corrosion)
- b. Suspended by messenger, with bare sheath or hose-type jacket
- c. Clamped to walls or columns, with bare sheath or interlock-armored

### Insulated, Braid-Covered Cable

- In metal conduit above or below ground (must be dry), standard or EMT steel, occasionally copper alloy or aluminum
- 2. In interlock-armored construction
- 3. In compartments above ground
- 4. On insulators, exposed, indoors
- 5. On racks, or trays, indoors

### Insulated, Nonmetallic-Armored Cable

- 1. Underground, in ducts directly buried
- 2. Above ground, on messenger, clamped to walls and columns, in conduit

#### Bare Wire and Cable

- 1. Outdoors on insulators on poles, brackets or roof supports
- 2. Indoors on insulators (special permission), open or in compartments above ground

tractor must always satisfy two basic requirements: load ratings, amperes, and interrupting capacity kva or mva. If he does not have the necessary information to determine the latter, a consultant should be called in. Before selecting air circuit breakers for secondary circuits, the first and most important decision is whether to use selective tripping or cascade operation.

### Selective Tripping vs Cascade Operation

In the selective system, breaker trips are so timed that the one nearest the fault (farthest from transformer) trips first. All breakers must be able to interrupt full short-circuit current available at their terminals. A minimum of equipment is disturbed and the method is by far, more satisfactory.

In the cascade system, the same connections may be used but breaker rating is changed. All tripping is instantaneous. Assuming 3 breakers in line, breaker A capable of full interrupting capacity, must have an instantaneous setting for 80% thereof; breaker B adequate for one half and breaker C, one third. Thus some smaller breakers may be used and investment reduced.

A NEMA ruling prohibits using plastic-case breakers cascaded with magnetic types; i.e., breakers in cascade must be of the same general type.

### Cable Selection

Cable should be selected so that under the installation and operating conditions selected it will provide longest life and the least trouble and at the same time the greatest economy. When these conditions have been fulfilled, the best cable has been selected.

It is difficult to set down rules for selection of cable since so many factors enter and are so variable from one job to another. Each job requires consideration of all these items best known only to the man most familiar with the work and with whom the contractor should confer.

You can easily pay too much for a suitable cable for the job; also you can select the wrong one. There are three essentials; conductor size, the insulation and the covering. The cable answering best to all three is the best selection, a balanced design.

### Selection.

The conductor size must answer these requirements:

Voltage drop and regulation

Temperature rise within the limits of the insulation

Reasonable energy losses

Cross section adequate for shortcircuit heating

The insulation must satisfy these requirements:

600 Volts

C

Temperature rise (ambient plus temperature rise from load)

Ease of installation

Effects of environment (moisture, fumes, chemicals, petroleum prodfumes, chemicals, acids, alkalies) High Voltage

Good physical properties Good electrical properties

The covering(s) must satisfy these requirements:

Adequate protection to the insulation against environment (moisture, chemicals, fumes, petroleum products, etc., sunlight, acids, alkalies)

Adequate in itself to withstand environment as above, plus abrasion resistance, impact etc.

Additional coverings on lead-covered cables may be needed against corrosion and electrolysis and against abrasion and impact (submarine, buried etc.)

Some 600-volt insulations, Types, T, TW, neoprene, are in themselves sufficiently rugged mechanically as not to require a covering and are approved for general purpose installation.

### Trade Names

Many types of conductors are sold under company trade names, often a convenient way of referring to the product, which, though it conforms to industry standards, often has additional properties. The industry standard often is a minimum. The trade name nails down the particular product. When you analyze these products, learn the industry standard it meets; that will afford a basis of comparison. Incidentally, Type RR (rubber insulation, rubber jacket) is outmoded and should be abandoned. Its principal successor is rubber insulation with neoprene jacket.

### Substitutions

A client may specify a certain cable by name or trade name. Often it is not available for various reasons, or may possibly be less satisfactory than another. By referring to industry standards as above, another cable or equal or better grade can be selected.

### Insulations

Rubber insulations comprise mostly the four rubbers plus Type RH-RW, a combination heat- and moisture-resistant compound, some network compounds, known notably for their overload capacity and moisture resistance. So-called "cold" rubber is coming into use. It is coagulated at lower than usual temperatures, and its use imparts greater toughness, better heat and moisture resistance to compounds incorporating it. It is used to date mostly in 600-volt cords and portable cables and in rubber-insulated, neoprene-jacketed power cables. Rubber with its braid, lead or neoprene coverEquivalent aluminum conductor sizes

Copper	Equivalent Aluminum Conductor Size		
Conductor Size	Code Conductors	Other Than Code Conductors	

	Awg	or Mcm
		THIS IS THE
		PREFERRED
		LIST
14	12	-
12	10	_
10	8	-
8	6	-
6	4	4
4	3	2
3	2	-
2	1	1/0
1	1/0	3/0
1/0	2/0	3/0
2/0	3/0	4/0
3/0	4/0	250
4/0	300	350
250	350	400
300	400	450
350	500	500
400	600	600
500	700	750
600	800	1000
700	1000	1000
750	1250	1250
800	1250	1250
900	1500	-
1000	1750	1500
1250		1750
1500		2000

ing is a good low voltage construction and can be used for general purposes; has good overload characteristics when made with GR-S compounds, mostly used now, because when overheated, it will coke and still offer some insulating properties, (when dry) if only by separation from other conductors. (Natural rubber compounds tend to stay soft.) Some oil-base compounds are used alternately for low voltage too but are premium products, usually only for special cases.

One of the most popular constructions ever built is rubber-insulated, neoprene-jacketed cable, suitable for all voltages to 15 kv. It is so versatile, it is almost a universal cable; can be installed in ducts, conduit, raceways, buried, aerially or a combination of these, in wet or dry locations, exposed to chemicals, oils, etc. By far. most footage is installed as single conductor. It is easy to handle, less bother in jointing and terminating, cheaper to install and better on maintenance than many other constructions, particularly lead-covered, and is lighter in weight. Men like to use it. See below for jointing and terminating.

Up to 2 kv, it is made with Type R, RH or RH-RW-insulation, above 2 kv, with ozone-resistant (butyl or oil-base, usually).

Thermoplastics, principally vinyl resin (primarily polyvinyl chloride, hence PVC, and copolymeric vinyls), are Types T and TW; similar but the latter approved for moist locations up to 60C without covering. This material has many properties rubber does not, particularly its chemical resistance and toughness, so it can be installed without a braid and takes less room in conduit. It is limited to 60C maximum copper temperature for general purposes, other PVC compounds up to 105C for appliances, etc. If sufficiently overloaded, all these will melt (not burn) and may allow conductors to touch. (Polyethylene has few applications in industrial plants. It also will melt at about 105C; its safe operating temperature is 80C.) Types T and TW are used interchangeably, according to the Code, for 600-volt wiring. They are specially good where conduit space is at a premium and in the presence of oils, greases, chemicals, etc., for power, lighting and control. Tank farms, refineries and chemical plants are good examples. They often last long after the conduit has disappeared in chemical plants.

Paper and varnished-cambric insulations are used on 600-volt and higher-rated cables. They have higher temperature rating (85C at 600V) and are high-grade insulations, used mostly for larger-size feeders, large motor and generator leads and high-voltage feeders. Paper cable must have a lead sheath and lead-sleeved joints. Varnished cambric also is used for these purposes and when greater flexibility is needed; can be used with lead or braid covering in dry locations, lead sheath in others, lead sleeved joints on lead-covered, taped joints on braidcovered cables. These two types, and asbestos-varnished-cambric insulated have the highest overload and shortcircuit heating capacity, with least damage, of any fibrous insulations. The latter is used mostly for hot locations because of its higher permissible operating temperature (110-100C for AVA and AVL and 90C for AVB).

High-Voltage Ozone-Resistant Rubbers—So called because they can be used at 2 kv to 28 kv; recommended up to 15 kv; designed to resist ozone



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## Basic Rules for Industrial Wiring Design

### . . . Starts on page 63

which may be a byproduct of high voltage operation. Principal types are butyl and oil-base. These are high-grade compounds and usually have both heat and moisture resistance along with ozone resistance and other desirable properties. They can be used as well as 600 volts and for some control circuits if the extra cost is justified; especially if high insulation resistance is needed on such as low voltage, low-current circuits.

Why So Many Rubber Compounds?
—First because no one compound is suitable for all purposes; second, each compound has a field of application where it is most suited; third, cost; unnecessary to buy butyl, for example, if Type RH will do.

Coverings-Lead sheath, braid and neoprene coverings are the principal ones. Neoprene can be extruded or stripped (over rubber insulation) or be a hose-type covering over lead sheath or varnished-cambric insulation. One of the most widely-used constructions is rubber insulation and neoprene-jacket, suitable for conduit, ducts, raceways, direct burial or a combination of any of these. It has excellent heat characteristics and is resistant to most chemicals and petroleum products, not affected by corrosion, sunlight and has no electrolysis problems: lighter weight than lead-covered.

Lead sheath, the only covering impervious to moisture, is the old reliable for rubber, paper and varnishedcambric insulations; best for moist and wet locations; can be covered with hose-type neoprene jacket for protection against corrosion and electrolysis.

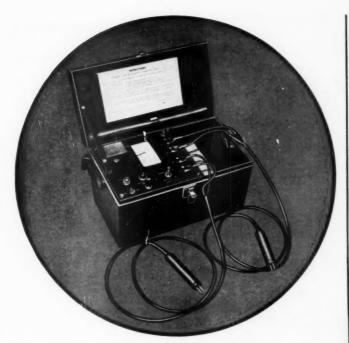
Braid is confined mostly to dry locations in conduit, some ducts, trays and troughs. excepting, of course. Types RW and RH-RW which are approved for wet locations.

Shielding—All cables should be shielded type for certain voltages and operating conditions. Be sure to specify shielded type when it is needed. Consult the cable manufacturer.

### Specifications

Reference to industry specifications assures one of a minimum standard of good quality. Many companies make cable products exceeding specification requirements with desirable character-

(Continued on page 70)



## This NEW INSTRUMENT Offers Greater Convenience in Field Use MEGGER® LOW RESISTANCE OHMMETER

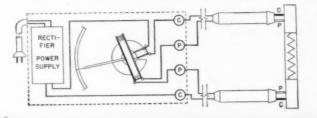
This most recent addition to the Megger family of electrical resistance measuring instruments is a general purpose type with self-contained power supply. The set is available in two models, both having the same ranges of 0 to 1000 and 0 to 10,000 microlums. Model 1B carries batteries and Model 1R has a built-in rectifier which plugs into any ordinary lighting circuit

outlet. Ample space is provided for the storage of all necessary leads and prods in a compartment of the same case.

The complete unit, with either battery or rectifier weighs only about 19 pounds. It is, therefore, easily portable and convenient to use in the field.

Write for Bulletin 24-46-ECM which describes these new instruments completely.

Schematic diagram of electrical connections for the Megger Low Resistance Ohmmeter



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Instrument News

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S Type wis battery swise in one of the test prod has dles.

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Butletin 21.85.ECM

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	Please	sen	d me	items	che	ked:	
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□ 24-46-ECM □ 21-85-ECM

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#### Basic Results for Industrial Wiring Design

#### . . . Starts on page 63

istics in addition. Principal specifications covering industrial cable are:

Underwriters' Laboratories, Inc .-Rubber and thermoplastic-insulated building wire, mostly 600 volts.

IPCEA\*-a, rubber- and thermoplastic- and b, varnished-cambric-insulated power cables, 600 volts and

AEIC#-Paper-insulated power cable. 600 volts and higher.

\* Insulated Power Cable Engineers Association.

# Association of Edison Illuminating Companies.

#### **Cable Terminations**

Paper cable must be terminated in potheads at all voltages. Varnishedcambric cables may be taped indoors at 600 volts and higher in dry locations but preferably are terminated in potheads. Rubber-insulated may be terminated without potheads up to 8 ky phase to phase indoors, and, provided a compound resistant to sunlight is used, up to 8 kv outdoors; in potheads in any location above 8 kv. Potheads, of course, always make a better job at any voltage. Some manufacturers recommend terminations without potheads at higher than 8 kv.

Rubber-insulated, neoprene-jacketed cable lends itself well to termination without potheads as it usually is singleconductor, easiest to handle and terminating takes little room. In making the terminal on this cable, be sure to cut back the jacket as directed, as some makers use a semi-conducting jacket and no jacket should be considered as insulation.

#### Conductor Size

Conductor size for load-current can be determined by referring to N E Code tables 1, 2 and 3 or to IPCEA tables of current rating for paper, varnished cambric and rubber-insulated cables and tables of voltage drop for various conductor sizes under many arrangements of conductor spacing, or consult the cable manufacturer for any specific case. The current-rating and voltage drop tables usually may be obtained in cable manufacturers' catalogs. The IPCEA tables are useful for primary and main feeders and take into account such items as load

(Continued on page 72)

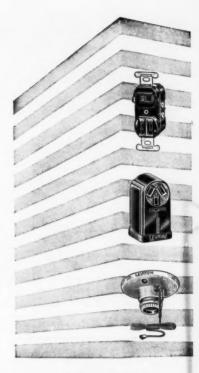
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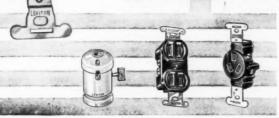
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### Basic Rules for Industrial Wiring Design

. . . Starts on page 63

factor, ambient temperature, voltage rating, insulation characteristics, grouping of conductors, type of installation.

Conductor size for short-circuit heating is another matter. With wider and wider use of circuit breaker protection on feeders and delayed tripping of breakers in series back to the supply, cable must be able to withstand short-circuit heating during the delay period. For example, a 100-hp motor feeder cable may be required to carry 15,000 amperes for some seconds, which may mean a much larger cross section than necessary for continuous load. Conductor size for this requirement should be based on allowable temperature rise, depending on the insulation, and time in seconds. Some such tables are avilable in the technical lit-

#### **Aluminum and Copper Conductors**

Copper conductors are preferred by many contractors because, of course, they know most about them and how to use them. Aluminum conductors now are being used more and more. Practically all low voltage and many high voltage cables and wires are available with aluminum. There are, however, a few things to keep in mind:

1. Current rating—The NE Code, 1951 states that the continuous ampere rating for aluminum conductors under Code jurisdiction shall be 84% of that of the same size copper conductor. This is not so good a guide to selection for low voltage industrial and commercial work. Voltage drop is better because many Code sizes based on current rating are inadequate for voltage

Copper—IPCEA tables principally for high voltage and primary cables, are available for copper conductors insulated with paper, varnished cambric or rubber, showing the permissible current ratings under various conditions of installation and operation; viz., in air, in ducts, aerially: 1- or 3-conductor 100% to 30% load factor, corrections for ambient temperature and other items. Information for any specific case may usually be obtained from the cable manufacturers or in catalogs and books of technical data published by them.

Aluminum—The procedure for cor-(Continued on page 74)

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Jenkins Bros. make Diamond Seal Friction and Rubber Tapes also, which meet ASTM and Federal Specifications.

### Basic Rules for Industrial Wiring Design

#### . . . Starts on page 63

rect selection of an aluminum conductor, until similar tables are available, is to select the correct copper size, for your installation requirements, then with the help of the table, obtain the corresponding aluminum size.

The accompanying table shows equivalent aluminum sizes for Code and other-than-Code conductors. The latter is the preferred list and should be used.

2. Voltage Drop—In all cases, to be safe, the aluminum conductors should be at least 2 AWG sizes larger than the right copper conductor. An aluminum conductor of the same size as a copper conductor will produce voltage drop in inverse proportion to their conductivities, 100/61. Therefore, if a copper conductor will carry 150 amperes 100 feet at 1-volt drop, an aluminum conductor of the same size will carry the same current only 61 feet at 1-volt drop. (or 0.61 x 150 = 91.5 amperes for 100 feet at 1-volt drop).

3. Conduit Size—A cable with aluminum conductor(s) of the same current rating or voltage drop as copper, will necessarily require a larger cross section and therefore have greater diameter; hence in larger sizes, a larger conduit may be needed. It doesn't hold necessarily in smaller sizes, depending on the case. Very few smaller sizes are used.

4. Connections - Terminating and jointing technique for all sizes aluminum conductors is still formative and not everybody agrees with it. Up-todate information should be obtained. Briefly, the technique for copper is unsuitable for aluminum; principal reason is the presence of aluminum oxide on the strands which forms an insulator and must be removed to make a good connection and prevent internal corrosion. Another is the 38% greater coefficient of expansion of aluminum over that of copper. High compression is paramount; during compression, the wiping action of the metal surfaces breaks the oxide film, giving low electrical resistance. Pressure fittings should be made tight and stay tight: a relaxation of pressure tends to increase oxide formation and raise resistance.

On one large job, the contractor used compression fittings up to 350,000 cm, argon welding for large sizes. According to the manufacturers, compression fittings and bolted connectors are

available for all sizes. Compression types are of aluminum material for terminals, taps and splices and may be preferable if the expense of tools is justified: can be used in small spaces as in switchgear; clamp types of aluminum or special copper alloy, both usually tinned when connected to copper bus bar. Both compression and clamp types are available for connection aluminum to aluminum and aluminum to copper. Compounds are recommended by some manufacturers to be used with these fittings, to keep moisture out and other reasons. Better results are claimed by using fittings made for the particular size conductor. not for a range of sizes. Sector-shape connectors are available for sector conductors so the conductor does not have to be deformed.

Argon welding is a good method if done right; must be fairly precise technique. The same may be said, to a lesser degree, perhaps, of soldering, for which fluxes and solders are available for EC aluminum, the common type used in electrical work. Other methods are the use of screwed fittings and other welding methods.

It is preferable to obtain from the suppliers, detailed instructions on the use of any fitting or method.

#### **Primary Feeders**

The proper selection of primary feeders, 5 kv and higher voltage rating, is subject to application of specialized knowledge for best results. If the contractor lacks this knowledge, it is preferable to consult the cable manufacturers, submitting full information.

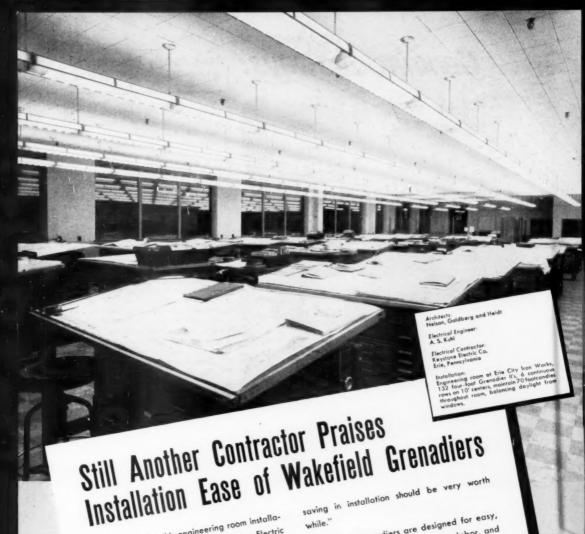
Principal insulations above 600-volt rating are paper, varnished cambric and ozone-resistant rubber, very little thermoplastic excepting for series lighting. The foregoing remarks on cable selection apply in general equally well to primary as well as to secondary feeders.

#### Secondary Feeders

Secondary feeders can consist of cables, busways or open wires. Openwire construction is probably cheapest to install but lacks mechanical protection, requires care in routing, reactance is greater than multi-conductor cable or 1-conductor in conduit; hence voltage drop is greater than for cable but about the same as for busways; indoors, requires special permission from the inspector.

Cable is most widely used. Aside from unusual cases, loads on feeders above 400 amperes are deprecated; cables become bulky and conduit expensive: more difficult to install;

(Continued on page 76)



After completing this engineering room installation of Wakefield Grenadiers, Keystone Electric wrote—"We highly recommend Wakefield Grenadiers for effective lighting and time-saving installation—particularly for the basic engineering features like the pre-installed strap and hook on stem that saves time in installation."

"We are looking forward to a new installation, for which the fixtures are on hand, that will use the new Wakefield 8' channel units. The time

Wakefield Grenadiers are designed for easy, while." one-man installation—to save time, labor, and to give your customer an economical job. They're available in an entire family of matching units; two and four lamps, fluorescent and slimline, in four and eight-foot channel lengths. For more detailed information, write to The F. W. Wakefield Brass Company, Vermilion, Ohio.

by..... Wakefield Designed for Contractors Over-ALL Lighting



#### Wagner Motor Starting Capacitors

You can be right every time...if you always replace with genuine Wagner capacitors. Just check the capacitor number, stamped on the Wagner Motor nameplate, and take all the guesswork out of replacements. You know that you'll get the exact same size—mounting brackets—terminals—and high quality that Wagner originally specified for the motor.

Do you have Wagner's Fast-Moving Parts Bulletin MU-122 and Motor Parts Catalog MU-40? If not, write for your copies today. Every repair shop can use these helps.



### Basic Results for Industrial Wiring Design

. . . Starts on page 63

amount of load dropped on a fault is considerable. Cable in conduit offers a high degree of protection. Interlocked-armor cable (Types AC, ACV and ACL) also offers a high degree of protection, is easy to install, can be used for secondary or branch feeders: often confined to cases where conduit is difficult to install or where distance is comparatively short: to 600-volt (or less) circuits, and to dry locations unless conductors are lead-covered; has higher current rating for same conductor size, and installed cost often is less than cable in conduit (more amperes per dollar).

Busways are used for take-off of several individual machine feeds in one area, particularly where regrouping or changing the entire area, as in auto plants, may be required at intervals.

Branch circuits usually are wire and cable. See N E Code for minimums.

Standardization of Cable Sizes

Even though for some applications, cables may not be loaded to their rated capacity, the contractor takes less time to order and install when using standardized sizes; the owners should be readily convinced on any job there are definite advantages. Some are:

1. Possible to order cable promptly without waiting for a detailed layout.

Possible to order large quantities of cable, conduit and fittings and save on quantity purchases.

3. Inventory and stocking are simpler, space is saved.

4. Unless load is accurately known, as in unit loads, choice of conductor size is but an estimate because loads cannot be determined precisely: better to use a standard size you know is large enough.

#### Lighting

The light output from incandescent lamps varies directly as the 3rd or 4th power of the voltage and the average life varies inversely as the 7th power of the voltage. Fluorescent lamps are not affected so critically excepting that when the voltage falls too far below rated, they may go out. Full-rated lamp voltage—and steady—is required, preferably within 1 or 2 volts above or below. Take lighting circuits preferably off nonfluctuating buses.

To avoid fluctuation, some plants use

separate feeders direct from the supply and step down to 3-wire secondary feedets as required.

#### Layout for Emergencies

Though they may seldom happen, the contractor may well consider emergencies. Here are some items that may help:

1. Liquid- and oil-filled transformers are claimed to take overload best. Fans of adequate capacity applied to these types will raise continuous rating by 15% to 20% or more, depending on design and operating conditions. Consult manufacturers for details.

2. Paper-insulated cable, per AEIC (industry) specifications, may be overloaded to specified emergency temperatures above normal, for an average, over several years, of one period (not exceeding 24 hours) per year, but for a total of not more than 4 periods in any 12 consecutive months; this without any appreciable loss of life expectancy. These higher temperatures may be translated into increased rating after conductor size and method of installation have been determined.

3. Varnished-cambric, some rubber and Types T and TW thermoplastic insulations may be overloaded to some extent, all dependent on several factors, but no standards have been set up. The rubbers include the higher-grade types such as ozone-resistant, Types RH. RH-RW, some network compounds. Consult manufacturers. It is better not to overload these type cables at any time for more than a few minutes; rather have reserve capacity in the form of adequate conductor sizes.

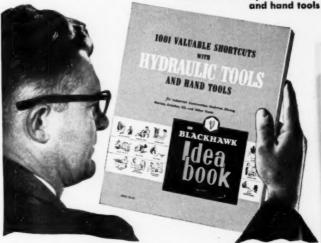
Items 2 and 3 above do not refer to short-time ratings for short-circuit heating of cables which endures usually for less than one-half minutes.



ARTHUR B. LOVATT, owner of Lovatt Electric Service Company, Hackensack, N. J., is shown here checking a winding job in his large, modern motor repair shop. Mr. Lovatt has been in the motor repair business for over twenty years and is a member of the NISA.

# Announcing . . . the great new 64-page BLACKHAWK IDEA BOOK

1001 shortcuts to save you time...money...
materials with hydraulic tools



Here's the greatest collection of ideas ever compiled on new uses for hydraulic tools and hand tools. The IDEA BOOK gives you the benefit of ideas developed and applied by hundreds of users of Blackhawk equipment. Most important, the IDEA BOOK will stimulate you to create your oun ideas . . . will show how Blackhawk equipment can solve special problems for you! So — send for ii! You'll want to read every page

— you may find a "gold mine" in any one picture.

You see, the same Blackhawk hydraulic tools you now use for bending pipe and driving knockout punches make many other jobs easier, faster, safer. With them, you can pull pulleys, move motors, install heavy equipment, handle many other allied jobs. Like so many others, you'll find savings in time, money and materials are often spectacular.

IDEA BOOK contains all the facts on how you can

#### WIN BIG CASH AWARDS

in big Idea Contest. Every 90 days Blackhawk will give generous cash awards and citations for the best original ideas using Blackhawk equipment. Get your copy of the IDEA BOOK today for complete details.

#### ASK "THE MAN WHO KNOWS"-

Representatives of leading supply houses have full facts on these products.

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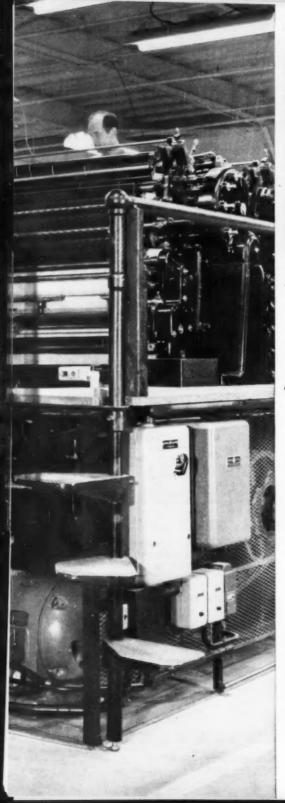
Headquarters for industrial hand tools plus the world's most complete line of hydraulic tools...

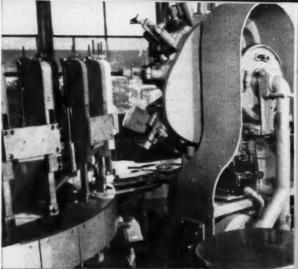
BLACKHAWK MFG. CO. Dpt. M-2082, Milwaukee 1, Wis.

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▼THE LORD BALTIMORE PRESS, in their new \$2 million plant, chose G-E magnetic starters for long-lasting protection on this huge Harris ITL press. Main drive is controlled by a fullvoltage, fuse disconnect, reversing G-E magnetic starter, while two more G-E magnetic starters protect feeder and delivery motors.

## Three more leading "G-E Magnetic



**EASY INSTALLATION** is another reason companies prefer G-E starters. Here, one is being installed on a Pneumatic Scale Corp. labeling machine. Note accessible wiring terminals all in front.



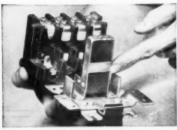
PNEUMATIC SCALE CORP. LTD. makes complex bottling and packaging machinery. They report that G-E magnetic starters give dependable service, fool-proof motor protection. Above, Pneumatic "bottling line" is being assembled. It cleans, fills, caps and labels—uses G-E magnetic starters to protect its motors.



THE VAN DORN IRON WORKS' Sales Manager J. J. Reichel, pointing to Van Dorn plastic molding machine, says, "G-E magnetic starters are the best long-term assurance we can give customers against motor burn-outs. We've used them on over 1000 machines and never a complaint on electrical equipment,"

#### industrial plants report:

## Motor Starters last longer!"



NO FAILURE after millions of operations is assured by exclusive features such as permanent air gap in magnet, above. It can't "wear out" because it is independent of striking surfaces ... prevents "sticking in" of magnetic structure.



EXCLUSIVE STRONGBOX COIL shuts out dust, oil, moisture; can't be damaged by slipping screwdriver—only maintenance tool needed.

The Lord Baltimore Press, Baltimore, Md., the Van Dorn Iron Works, Cleveland, Ohio, and Pneumatic Scale Corp., Ltd; Quincy, Mass. are among the thousands of companies now profitably using G-E Magnetic starters for longer lasting protection.

This extra long life is due to many exclusive G-E features, such as the permanent air gap, cold-moulded are chute, and the famous G-E "Strongbox" Coil. General Electric magnetic starters eliminate metal-to-metal friction, have permanent lubrication, self-cleaning silver contacts . . . everything you need to operate and protect your motors . . . longer.

WIDEST VARIETY: General Electric manufactures the most complete line of motor starters. You have your choice of all popular NEMA sizes in General-purpose, watertight, dust-tight and explosion-proof enclosures. Also, G-E starters are easily modified to meet special requirements.

**OFF-THE-SHELF DELIVERY:** You can get G-E starters, right now, by contacting your nearest G-E Apparatus Sales office or authorized distributor. For more information, send coupon today. *General Electric Co.*, *Schenectady* 5, N. Y.

## GENERAL 🚳 ELECTRIC

Send me your new bulletin Gi	Electric Co., Schenectady 5, N. Y.  A.5781 on G-E magnetic and manual starters, and control in immediate project () for information only.
NAME	TITLE
COMPANY	
ADDRESS	



A. B. Sutherland Company, Lawrence, Mass. Lighting Engineer: H. R. Loeschner, Lowrence Gas & Electric Co. Lighting Consultant: Ralph I. Nuse, Graybar Electric Co., Boston, Mass. Contractor: Lawrence Electric Supply & Construction Co. Fixtures: Litecontrol No. 5928 8 foot slim-

line, No. 5926 6 foot slimline, and No. 5924 4 foot slimline flatures, with No. 9015 Holophane Controlense." Lifecontrol No. 5900—22 adjustable supplementary Spolities. Watts per square foot: 3.8 (slimline only). Average intensity on counters: 50 flootcandles in service.

## Hight! Bright!! and Sales Right!!!

This department store is light in a cheerful way... bright, but not "glarey"... right, in the way that makes cash registers ring.

Looks like a brand new store, doesn't it? Actually, it's a dramatic example of what skillful remodeling can do. Design is simple, neat, fully integrated OM HOLOPHANE CO., INC.

with the unobtrusive Litecontrol Recessed Fixtures.

Spotlites are arranged in the rows to give extra light exactly where needed. And even the spotlites are recessed to keep the ceiling smooth and attractive.

To save time and trouble . . . to get results you'd be willing to advertise . . . call in LITECONTROL on your next lighting problem.

Why not write today!



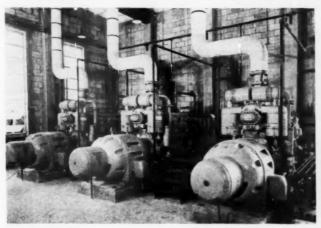
LITECONTROL



LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF PLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

## **Practical Methods**



**EMERGENCY POWER** for Jackson Memorial Hospital in Miami is provided by this trio of Caterpillar D397 diesel generator units. Each is rated at 314 kw.

#### Automatic Test Cycle Speeds Switch Production

PRODUCTION

Regardless of high winds, hurricanes or the seasonal storms which lash the Florida coast, normal operation is always assured at the Jackson Memorial Hospital in Miami, Florida. A current construction program, which will expand the hospital to 1200 bed capacity, includes a power house with sufficient standby generating capacity to carry the full hospital electrical load in any emergency.

Hospital Has Full

Load Standby Service

Three Caterpillar D397 diesel generator sets are installed in the power house. Each unit is rated at 314 kw and provides 3-phase, 60-cycle current at 4160 volts. Transformers step down the voltage to the 120/240 utilization voltage of the hospital electrical system.

The generator sets will operate in parallel with the use of a panel switch-board. Special steel-grating platforms alongside each engine facilitate checking, lubrication and servicing. Exhaust mufflers and intake air silencers help provide quiet operation. Air starting is used and engine cooling is by means of heat exchangers.

The trio of generators, designed and produced as packaged units, protect the hospital's combined medical-surgical-dental facilities against power failure; will handle the entire hospital electrical load in case of an emergency.

Electricians who have installed and used the familiar Levolier lever-action switch made by the Electrical Division of the McGill Manufacturing Co., Valparaiso, Indiana, know of the rugged construction and lifetime guarantee of the unit. Behind this guarantee stands quality materials and the wealth of production know-how at the McGill plant.

Indicative of such know-how is the automatic test unit recently installed in the modern conveyorized production line. Whether or not a switch leaving the assembly presses reaches the packaging end of the conveyor line depends upon the answer given by this electrically controlled machine, designed and built by McGill's chief production engineer Marvin C. Carlson and the Robert L. Miller Laboratory.

As switches come off the assembly presses they fall on the conveyor belt and are diverted into tote pans at the test unit. The operator takes the switches from the pans and "loads" them into twelve individual blocks mounted on the perimeter of a covered turntable. As the turntable rotates on its vertical axis, each switch passes seven stations. The first places the switch on the "off" position ready for the test. The next four stations on the circle actually test-operate the switch

eight times under a 750-watt lamp load at from 240 to 250 volts. Switches are "T" rated at 6 amps, 125-volts, or 3 amps., 250-volts.



**SWITCHES ARE LOADED** in holders on perimeter of slowly rotating turntable; go through first test station; then . . .



**GET A SHOT OF GREASE** from airoperated nozzle at second and third test stations. Switches undergo fourth test, then . . .



ARE EJECTED TO conveyor belt, if all tests have been passed; or rejected into covered chute at right if defective.

## Why Good Electricians Choose



**4P Geared Pipe Threader** 



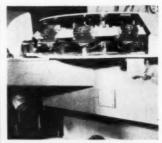
No. 4P, 21/2" to 4" Conduit

#### Extra easy to carry and put on conduit

- Balanced loop handles—easy to swing 4P where you
   want it.
- Mistake-proof workholder sets to size before put on conduit—only one set screw.
- ★ Practically no upkeep—drive pinion in oilless bronze bearing; safe enclosed gear.
- ★ 4 sets of 5 high-speed steel dies for 2½", 3", 3½", 4" conduit. Ratchet handle; PRIDATO Universal Drive Shaft available.
- \* Buy efficient 4P at your Supply House.

THE RIDGE TOOL COMPANY . ELYRIA, OHIO





CLOSE UP OF TURNTABLE showing individual switch holders and array of limit switches and cams to control test sequence.

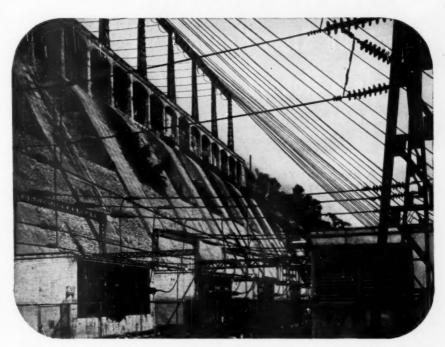


BANKS OF RELAYS in vertical cabinet operate limit-switch actuated circuits for various phases of the complete test cycle. Load lamps are at top of cabinet.

Each test station turns the switch "on" and "off" under load. In addition, two of these stations (second and third of the test group) lubricate the switch operating and contact points. This is done with a lever-mounted spray-gun nozzle adapted to handle controlled quantities of grease and operated by air through limit-switch actuated solenoid valves. Relay circuits connect and disconnect the lamp load at each test station; are so interlocked that the test cycle is practically jamproof.

Two more stations follow the four "test" stations on the circle. One is the "eject" station for switches which have successfully passed the test cycle; the other is the "reject" station for those units which have failed at one or more test stations. A solenoid plunger in the center of each switch block on the turntable throws out the switch at the last two points as predetermined by the machine's relay circuits. Switches which have weathered the test fall on the production line conveyor belt and continue to the pack-

## V. C. CABLE



## Specify Roebling V. C. Cable for top resistance to heat, oil and grease

THROUGH continual laboratory developments and progressive manufacturing methods, Roebling Varnished Cambric Cable has been constantly improved. Today this cable has absolutely top resistance to heat, oil and grease... and it's the most dependable cable you can use for leads on generators, transformers, motor and oil switches, and for general distribution of heavy power loads in manufacturing and industrial plants.

Roebling V.C. is made in single conductor sizes

from 2,000,000 C.M. to #14 A.W.G.; in multiple conductor sizes from 750,000 C.M. to #14 A.W.G. Recommended for use to 17,000v between phases in single or multiple conductor construction; and to 26,000v for single conductor grounded neutral.

Large quantities of Roebling's complete wire and cable line are now required for rearmament. We and our distributors will, however, do all that we can to meet your needs. John A. Roebling's Sons Coapany, Trenton 2, N. I.



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- CINCINNATI, 3253 PRODONIA AVE - GLEVELAND, 701

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RECTOR BY - OOEBSA, TEXAS, 1920 C. 2NO BY
- FILLADELPHIA, 220 VINE BY - PITTSBURGH
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3001 DELMAR BLVD - TULSA.
321 M. CHEYENNE BY -

EXPORT BALES OFFICE.
TRENTON 3, NEW JERSEY





Garcy is always finding new ways to make my job easier . . . and

# This New GARCY Adjustable Stem Hanger is a Honey!

ADJUSTS AS EASILY AS A-B-C...SAVES TIME...SAVES MONEY

Here's How It's Done...



## A. STEM HOOKS ONTO HICKEY...an easy hook-on attachment. No nuts or bolts needed. Canopy covers standard outlet box, whether recessed or surface mounted.





B. STEMS ATTACHED TO FIXTURES ON THE FLOOR before hanging. Easier to handle . . . faster to work with.



C. EASILY ADJUST-

ED . . . a few turns of the stem lengthen or shorten it to compensate for uneven ceiling conditions.







GARDEN CITY PLATING & MFG. CO.

1750 NORTH ASHLAND AVENUE . CHICAGO 22, ILLINOIS



VISUAL INDICATION of what is happening during test cycle is given operator by pilot light panel on face of relay cabinet. Air hose connections in foreground are for grease nozzles at two test stations.

aging department; those which have failed are thrown into a covered chute and end up in a waiting tote box.

The test machine is an ingenious combination of levers, cams, limit switches, solenoids and relays. While the former are mounted on and around the turntable, the relays are compactly mounted in a large enclosed vertical panel at the back of the test machine. The face of this panel contains a series of pilot lights to give a visual indication of what is happening to the switch under test, also whether all cams, limit switches and relays are functioning properly.

Before development of this automatic test machine, all switches were lubricated and test-operated by hand. When the accompanying photos were taken, the machine was breezing through 1,600 switches per hour. It has a capacity of 2,100 units per hour when the turntable motor speed is increased.

It is obvious that this new test unit is paying off in production for McGill. More than that, it completely eliminates the possibility of "human error" which is always inherent in operations of a highly repetitive nature.

#### Scrap Metal Rig Speeds Wire Handling

WIRING

Wire handling on the job has been made a more efficient and quicker chore through the use of a wire spooling rig made up at the Arrow Electric Company, Waco, Texas. This rig has proved particularly useful in handling Give your clients real circuit protection...

#### INSTALL AB-I CIRCUIT BREAKERS

Customers know Westinghouse AB-I Circuit Breakers offer outstanding circuit protection for today's needs, for tomorrow's expanding power demands.

Users save because service is restored in seconds after a fault is cleared. Anyone can safely turn the handle to "Reset" and back to "On". If the fault continues, the breaker merely trips again. Downtime is minimized, workmen aren't exposed to "live" parts.

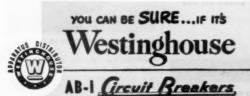
In contrast to other types of circuit-protective devices, AB-I Circuit Breakers require no replacement elements.

On shorts and dangerous overloads, AB-I Breakers trip instantly. Harmless overloads and peaks are carried without circuit interruption. Calibration stays exact and tamper proof for the life of the installation. Trip-free AB-I Breakers cannot be held or locked "On" against a fault.

Easy-to-install AB-I Breakers are available for almost every NEMA application. Call your Westinghouse Distributor or write for B-5456, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-30094



"Of course, circuit breakers save money."



Collings and Collins





BRANDED JACKETS!

No mistake... You know you are getting Certified. You reed at a glance cable type, size, voltage, "P116BM"... which indicates approval by the Pennsylvania Bureau of Mines, and acceptance for listing by the U.S. Bureau of Mines. Easy to measure... "Branco" is repeated every 2 feet.

With Bronco 60 Certified you know you are getting a full 60% by weight of Neoprene in your cable's protecting jacket because its contents are certified.

More Neoprene makes long-lasting Bronco 60 Certified more resistant to oil, acids, alkalis, ozone, gasoline, salt water.

In addition, with Bronco 60 Certified you get: 1. Cold Rubber Insulation. 2. Branded Jackets. 3. Superior Flexibility.

So, BE CERTAIN, GET CERTIFIED

— the greatest cord value on the
market!



WIRE HANDLING RIG was constructed of scrap metal and old coffee cans in the shop at Arrow Electric, Waco, Texas.

the large amounts of wire used on lighting installations.

Basically, the rig is a simple construction which uses a common assortment of scrap metal parts. It consists of a light folding frame of welded angle iron. The frame has folding legs, much like an ironing board, and is easily transported in its folded position on a pickup truck. On the job, the frame is set up easel-fashion on its long and short legs. Four galvanized metal panniers are mounted on the frame and revolve on 1-inch spindles which are part of the frame. The panniers are 18-inches in diameter and 6-inches deep. The spool in the center of each pannier is an old two-pound coffee can. Four lengths of half-inch scrap flat iron are welded to the bottom of each coffee tin and provide convenient handles.

Four types and gauges of wire can be spooled simultaneously from this fixture. The wire is spooled through simple "eyes" which are part of the frame. Up to 150 feet of wire can be spooled in each pannier.



electrical contractor P. J. Falson of Falson Electric Co., Chicago, demonstrates his recently patented Outlet Lo-kater in a home he wired. Device is a pry-out center plate in outlet box plaster cover. Plate "knob" extends through plaster to spot outlet; can be pried out with screwdriver; keeps boxes and conduits free of plaster.



## **ONE Screw Holds BOTH Cable and Cap**

and cuts your installed costs when you use #321...90° T&B Tite-Bite Connectors\*

One twist—it's open Slip off cap & insert cable Slip cap on & tighten screw ... that's all!

Think of the time and money this new #321 Tite-Bite Connector will save on your wiring jobs. Only one screw! Twist . . . it's open-twist . . . it's closed-tight! Because this one single-turn screw holds both cap and cable, you do a faster, neater job every time.

"Tite-Bite" comes as a single unit . . . no loose parts to drop. Patented hook construction, case-hardened steel locknut and double thick bushing give you safe, sure, trouble-free installation every time . . . for all time! So insist on #321 Tite-Bite Connectors-the new onescrew connector that cuts your installed costs lower than ever before.

#### ENGINEERED RIGHT ... DISTRIBUTED RIGHT!

Tite-Bite Connectors are typical of the many T & B quality fittings recently re-designed to give you outstanding performance at lowest installed costs. Like all T & B fittings, they're furnished under the T & B Plan 100% through your local T & B distributor.

Remember, you always cut your installed costs by using T & B fittings . . . and by securing them through your local T & B distributor.

#### THE THOMAS & BETTS CO.

34 Butler Street. Elizabeth 1, New Jersey



MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899



INDUSTRIAL SWITCHES TYPE "D" SAFETY SWITCHES DOUBLE THROW SAFETY SWITCHES DISTRIBUTION PANELBOARDS STANDARDIZED TROUGHS.

S. REVERSING CONTACTORS AND STANTERS COMBINATION S. REVERSING CONTACTORS AND STANTERS COMBINATION OF THE COMBINATION STANTERS COMBINATION OF THE COMBINATION

## Stab-lok

REGISTRATION APPLIED FOR

. NTPR PANELBO

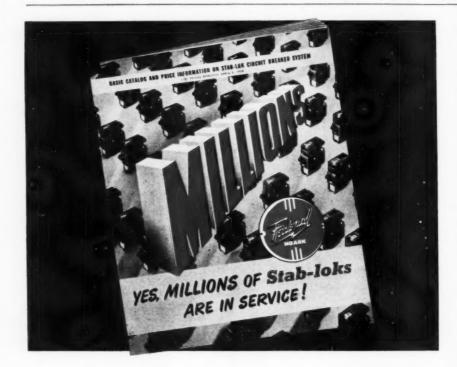
COLUMN TYPE PANE

CENTERS SWITCHED

LBOARDS . LIGHTING

REVESING CONTACTO STING ANELS - STANDA - MACHETIC MOTOR ST

· MULTIBREAKERS



TWO YEARS AGO Federal Noark introduced Stab-lok Circuit Breakers...and put modern circuit protection into the price range of fuse boxes! Sales were enormous. Millions of Stab-loks were installed within a few months. And the demand has kept on growing, for Stab-lok is the only popular-priced breaker whose dependability has been proved on such an amazing scale.

Federal Noark Stab-lok Circuit Breakers come in a standard range of amperages, in both single and simultaneous trip double pole. Most of the Stab-lok Enclosures are of the convenient "combination" type for either flush or surface mounting. Their capacity range constitutes a complete line for load centers up to 20 circuits, panelboards up to 42 circuits, and switches up to 60 amps.

At the right are shown several newer and special devices which further extend the Stab-lok system's scope of usefulness. And send today for the new Stab-lok Basic Catalog that gives you the whole Stab-lok story plus full purchasing and price information.

Federal Electric Products Company, 50 Paris Street, Newark 5, New Jersey.

TROUGHS - MULTIBREAKERS - NO STARTER

REVERSING CONTINUES - TYPE "D" SAFETY SWITCHES & CIRCUIT TEREAKIR THE SANGE PULLOUT SWITCHES - MAIN AND EARGE PULLOUT SWITCHES - MAIN AND EARG

MAGNETIC CONTACTORS
SWITCHBOARDS LABORATORY SWITCHE
LORGINIT BREAKER TYPE PANELBOARD

HELBOARDS . COLUMN TYPE PANELBOARDS . SUSIBLE DISTRIBUTION ANELS - SOLENOID TYPE RELAYS - PUSH BUTTOM STATIONS - TYPE ABI INDUSTRIAL CIRCUIT BA THOUGHS FOR SOCKET TYPE METER . AT WIRING TROUGHS . MULTIBREAKERS . HTPR PAHELBOARDS . NIPS THE ... THROW SAFETY SWITCHES . MAIN AND RANGE PULLOUT SWITCHES . MAIN SERVICE AN CONTROL CENTERS . SWITCHBOARDS . NG PANELBOARDS . CIRCUIT BREA STIC MULTI-SPEED STARTERS. + R

## CIRCUIT BREAKERS ARE SWEEPING THE INDUSTRY!

#### New and special devices that make Stab-lok today's most complete line ...

3 phase, 4 wire loadcenters suitable for installation in stores. factories, and similar locations for controlling lighting, small motors and appliances.



N\$412 — Capacity: 12 single or 6 double pole Stab-loks in any posi-tion. 100 amp. mains.



414 - Capacity: 14 single or 4 double pale Stab-loks and 6 sin pole Stab-loks. 70 amp. mains. loks and 6 single



N5418 — Capacity: 18 single or 8 double pole Stab-loks and two single poles. 100 amp. mains.

Ideally suited for houses with electric range and dryer.



116-68C — Capacity: Main block, 2 double and 2 single pole Stab-loks; Branch block, 8 single or 2 double and 4 single pole Stab-loks, 100 amp. mains.

Especially suited for medium or large size homes where several 120/240V. circuits and as many as 10 lighting circuits required.



182 — Capacity: Top bus, 4 double pole Stab-loks; Bottom bus: controlled by 1 double or 2 single pole Stab-loks with handle extensions as a main, feeding 5 double or 10 single pole branch circuit breakers. 100 amp. mains.

An inexpensive, general-purpose 20-circuit panel for controlling lighting and appliance loads.



182-20 - Capacity: Sequenced bus provides for 10 double pole Stab-loks of apposite polarity. 20 single pole or a combination of single and double pole Stab-loks can be used.

Panelboard for larger residences and for homes heated electri-



LA2600 — Capacity: 18 single and 2 double pole Stab-laks, or 6 double and 10 single pole Stab-laks. 200

FEDERAL ELECTRIC PRODUCTS COMPANY 50 PARIS STREET, NEWARK 5, NEW JERSEY





MAIN AND RANGE PULLC

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AL CIRCUIT BREAKERS

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ITION PANELBOARDS . CIRCUIT BREAKER TYPE S - REDUCED VOLTAGE . MAIN AND RANGE

----- ACI INDUSTRIAL SWITE

REXUNIT PLUCIN DISTRIBUTION PAR STABLES - AUTOMATIC TRANSFER PANELS - SOLENOID TYPE R THE HONTING PANELS STANDARDIZED TROUGHS FOR SC

STANDARDIZED TROUGHS FOR SOCKET TYPE METER . AT WIRING TROUGHS . MULTIEREAKERS MOTOR STARTERS - REVERSING CONTACTORS AND STARTERS

#### CEILING OF LIGHT

#### New! Leaderall Suspension Clips

New grooved suspension clips of steel hold louvered plastic units firmly at end of adjustable tie rods to form a completely level, rigid ceiling at any desired height.



For joining 2 and-to-end section



For 4 inter-



For finishing individual corners

High footcandles...low brightness

Leader's plastic louvered ceiling provides light from wall to wall, evenly distributed and properly shielded for maximum efficiency, freedom from glare, and minimum shadows. The Leaderall grilles are easily installed, instantly removable... feather light, yet tough and warp-proof. May be used with any type of fluorescent fixture, in finishing new ceilings or remodeling old ones. No interference with air conditioning or sprinkler systems. Ideal lighting for drafting rooms, a wide variety of commercial interiors, offices, cafeterias.

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EAUCH America's No.1 Lighting Equipment Manufacturer

LEADER ELECTRIC COMPANY • 3500 North Kedzie Avenue, Chicago 18, Illinois Leader Electric-Western: 800 One Hundredth Avenue, Oakland 3, California Campbell-Leader, Ltd.: Brantford, Ontario, Canada

## **Modern Lighting**



HIGHLIGHTED BACKGROUND, obtained through the installation of R-52 lamps in the high-bay area of Western Machinery's Sacramento machinery-manufacturing plant, contrasts sharply with the low-intensity foreground which had not been relighted at the time this photograph was taken. Average intensities in the two working areas are 23-fc (reflector lamps) and 5-fc (conventional units).

#### Effective Industrial Lighting 100 Footcandles for Uses R52s In High Bays

High-bay areas of the Western Machinery Company's Sacramento (California) manufacturing plant were recently relighted effectively and inexpensively with a series of R-52 750-watt floodlamps mounted 24 feet above the working floor on an approximate 19-by-25-foot spacing pattern. Intensities of 30 footcandles are obtained directly under units, while overall averages of 23-fc result from this installation which uses lamps with built-in reflectors to replace conventional RLM reflector units that formerly delivered an inadequate 5-fc average. The installation, designed by the Utility District's lighting engineers, was placed in operation in several stages; beginning with an experimental pilot layout in the higher of two bays, expanding to the second bay after the first installation had been enthusiastically approved.

Since the mining and milling machinery produced in the plant is of a custom-made variety, figures on stepped-up production are inconclusive. However, measured by such intangible factors as employee morale, lessened fatigue, decreased maintenance and lamp life, the installation is significant. It also indicates that adequate lighting for high-bay industrial plants is obtainable without necessitating a major investment in fixtures.

### Industrial Machine Shop

When the Alba Engineering and Manufacturing Company of Angeles entered the fabrication field to produce defense-sponsored plane parts, it was with the understanding that an imperfect product was useless to the government and that high-grade workmanship and high-grade lighting were synonymous. An average intensity of 100-footcandles was therefore established as a standard lighting requisite, and relatively close parallel lines of continuous fixtures were installed to provide a minimum of shadows along lathe beds and milling positions.

As installed, fixtures are 4-lamp units, with 96-inch T-12 75-watt fluorescent lamps operating with 430-ma ballasts. Mounting heights are 16 feet from the working floor, while centerto-center distances between rows are 8 feet.

As predicted, rejected work decreased abruptly when local lighting on the individual machines was replaced with this over-all installation, and output under these lighting conditions more than justified the expense of fixtures, lamps, ballasts and wiring.

The installation was made by "Elserco-Electricians" of Los Angeles.

#### French Use Dual Light In Hospital Wards

A dual fluorescent lighting unit, designed especially for use in hospitals, has been installed and is in service in the hospitals in Tours and Nantes, France. These units are of the directindirect type, designed for mounting on the wall in private rooms or wards. The unit is installed a little less than six feet from the floor above the head of the hospital bed.

This wall light is a box-like con-



REJECTS WENT DOWN as lighting levels went up as a result of this 4-lamp continuous-row T-12 430-milliamp installation in the 12,500 square foot industrial machine shop operated by the Alba Engineering and Manufacturing Company of Los Angeles, California.

# FACTS PROVE JEFFERSON Best of All

#### FOR MERCURY LAMP OPERATION

Make Your Own Comparison -Check the FACTS-Only Jefferson has all the Vital Features

Nine major design and construction features vital to top-flight transformer service, economy, and ideal lamp operation are listed below. Modern up-to-date Jefferson Transformers incorporate every one of these features to give you unmatched value in every detail.



quickly converted to pole-top units by adding Jefferson patented universal adaptors,

THE NINE MAJOR FEATURES	JEFFERSON TRANSFORMERS	Transformer A	Transformer B
Press-fit riveted core	YES	YES	NO
Q Leads stapled to core for positive strain relief	YES	NO	NO
Color coded and tagged leads	YES	NO	YES
Full sub-panel for rigid core and coil mounting with stamped lead designation	YES	YES	МО
Hot-dipped galvanizing on all out- door types	YES	NO	NO
Deep Drawn cases on all outdoor types	YES	но	NO
Solidly welded mounting bracket with locking holes plus key slot	YES	NO	NO
Universal Pole-Top Adaptor for 2½-4" O.D. Poles (a stock reducing feature)		NO	NO
"Dura-Gray" harmonizing finish for modern, attractive installations		NO	NO

For complete details and data on both outdoor and indoor type Jefferson Mercury Lamp Trans-formers, write for 16-page illustrated Bulletin 521-5. A copy is yours on request.

JEFFERSON ELECTRIC COMPANY Bellwood, Illinois





**DUAL LIGHTING** is provided by a new type fluorescent hospital ward lighting unit for hospitals in Tours and Nantes, France. Unit uses two 20 watt fluorescent tubes, one for indirect and one for direct lighting.

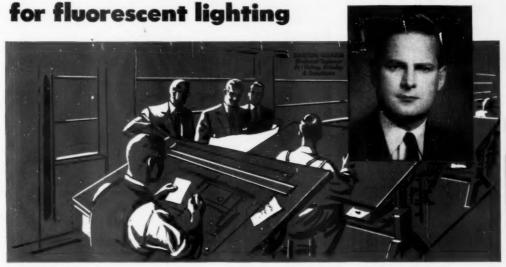


WARD LIGHTING unit is open at top, louvered at bottom, and each section may be turned on separately or jointly.

tainer made of sheet metal and finished to match the wall. Its interior is divided into two compartments, each holding a 20 watt fluorescent tube 60 centimeters (approx. 24 inches) long. Light from the upper tube is reflected upwards to the ceiling and against the upper side wall, to provide soft, diffused indirect lighting. The lower tube directs the light downward and out over the head of the bed. The bottom section of the unit is louvered to restrict the light to the area used by the patient in the bed for reading. Switch control may be provided so that either tube may be turned on or off separately, or both tubes turned on simultaneously. The direct lighting is used by the patient for reading, or by the doctor for examination of the patient, usually in combination with the upward light.

This hospital dual light was developed by the Compagnie des Lampes (Mazda) with the help of Dr. Antonin Mans, Inspector General at the Ministry of Public Health. Object of its design was to provide both a soft indirect light and a stronger illumination when desired for the patient, with maximum eye comfort and convenience. Designated as the Mazdafluor AC 220, this unit gives all the benefits for which designed.

Architectural firm tells why
it always specifies CERTIFIED BALLASTS



Fulton, Krinsky & DelaMotte, prominent Cleveland architectural firm specializing in schools, requests CERTIFIED BALLASTS in *all* fluorescent fixtures they specify.

Mr. Barton Quarm, their electrical engineer, says, "We always specify Certified Ballasts because we want trouble-free installations. Client satisfaction is assured by using Certified Ballasts."

More and more CERTIFIED BALLASTS are being specified and used because CERTIFIED BALLASTS assure—

Full Lamp Life

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Maximum Ballast Life

CERTIFIED BALLASTS are made to precise specifications, then tested by Electrical Testing Laboratories, Inc., which certifies they conform to these high standards.

Write for complete information on the types of CERTIFIED BALLASTS available from each participating manufacturer.

Participation in the CERTIFIED BALLAST program is open to any manufacturer who complies with the requirements of CERTIFIED BALLAST MANUFACTURERS.



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Indoor & Outdoor Lighting for Every Need

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**RELIGHTING INSTALLATION** in the Genesee Bank, Flint, Mich., utilized the existing wiring; raised footcandle level to 30 in the center area and to 70 along the sides and above the tellers' counters.

#### Bank Relighting Utilizes Existing Wiring

Increased light intensity keynotes a new relighting installation in the Genesee Bank, Flint, Michigan. In this installation, the layout and appearance of the new fluorescent luminaires offer the further advantage of effectively complementing the interior architectural construction.

The former lighting installation consisted of recessed incandescent fixtures in the ceiling above the center floor area and on the under side of suspended ceiling areas overhanging the balcony on one side of the store and the open office area on the other side. Inasmuch as the wiring for this installation represented extensive branch circuiting throughout the complex ceiling, it was decided to use this wiring for the new installation.

In the design of the new installation, the layout of the fluorescent luminaires eliminated a major problem. Removal of the recessed incandescent fixtures left openings in the ceiling areas which had to be covered. The solution was found in pairing Mitchell, Model C Module fluorescent luminaires.

Over each opening in the ceilings, two Module units, measuring 16½ by 48½ inches, were placed side by side. These pairs of modules were laid out in linear and block patterns on the ceilings, conforming to architectural style. A continuous row of single Model C units was mounted under the balcony directly above the tellers' counters. Each single Module unit contained four 40-watt, 48-inch T-12 lamps.

Lighting results were an appreciable improvement over the previous installation. A full 30 footcandles were obtained in the center area of the bank. Along the sides and above the tellers' counters, lighting intensity was raised to 70 footcandles.

#### Louvered Geiling Gives Illusion of Size to Small Wedge-Shape Office

Smart architectural design by J. T. Beem, and a carefully-installed louvered ceiling by the Keith Electric Company, creates an illusion of considerable size in a small wedge-shaped office occupied by the Union Pacific Railroad Company in Beverly Hills, California.

Since the office incorporates large areas of glass and since business hours rarely extend into the evening, initial thinking on the lighting problem considered the possibility of relying on reflected outdoor illumination and installing only incidental auxiliary artificial light in the office itself. This proposal was quickly abandoned however with the realization that, to be effective as a public-attracting travel center, the interior would have to be as bright or brighter than the sunlighted adjacent sidewalk areas.

As a result of this premise a louvered ceiling was selected, custom built to completely fill the irregularly-shaped ceiling panel. Louvered panels are 4foot squares with cells measuring 2-by-



TICKET OFFICE on small wedge-shaped corner property called for ingenious architectural and lighting techniques.



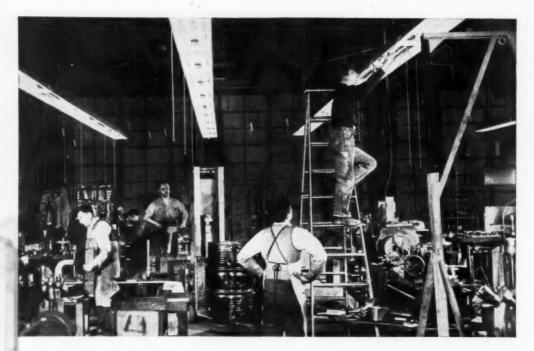
WALL TO WALL CEILING panel of backlighted small-cell design creates impression of size in this small office. Installation of pink lamps around borders of
room provides pleasing transition from
the coral of the sandstone masonry walls
to the flat white of the central louveredceiling area.

2-by-2 inches. This suspended ceiling is at a height of 8 feet above the floor, while continuous rows of standard preheat 4-foot fluorescent lamps are mounted 18 inches above the ceiling level on 18-inch centers.

In addition to the illusion of considerable expanse, another illusion is that of color, for although fluorescent lamps are standard cool white above the central desk area, rows of pink lamps were installed around the borders of the room to provide a harmonious transition between the white CEPCO Louverall ceiling panels and the coral sandstone masonry which flanks the all-glass entrance.

Maintained lighting intensities due solely to artificial sources range between 65 and 70 footcandles. Auxiliary lighting reflected from adjacent walks and buildings raises the daytime level well above the 100-fc level.





## Now is not the time to interrupt production

#### Make sure the fluorescent fixtures you buy use G-E Watch Dog\* starters

Worn-out lamps don't blink in fixtures equipped with General Electric Watch Dog starters. They're automatically cut out of the circuit to be replaced after working hours.

No more distracting flicker from old lamps. No more emergency calls for a maintenance man. No more ladders to disturb production. Starters last longer, too.

So . . . make sure all fixtures you buy display the Watch Dog tag or sticker. It's your assurance that the man with the ladder will stay out of your production picture. Section Q5-818, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

\*Registered Trade-mark of General Electric Co.

You can put your confidence in\_



Fixtures equipped with Watch Dog starters usually display the black, red, and yellow General Electric Watch Dog tag or label. Or you can specify these starters. 34 million



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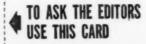
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## Product News



#### **Explosion-Proof Fixture**

A 200-watt explosion-proof lighting fixture for flush mounting in ceilings. Type RCDE-8 fixture is available with an 8-inch lens with symmetrical lighting distribution for general illumination or with prismatic lens with a symmetric distribution for special applications. Unit with symmetrical general lighting distribution is suitable for use where appearance is an important factor, where headroom is limited, or where surface or pendant-mounted fixtures would be an obstruction to overhead equipment, such as cranes, hoists, etc. The prismatic lens fixture can be used for the illumination of control boards and panelboards in petroleum refineries and chemical plants, the fixtures being mounted in the ceiling adjacent to the boards with the lenses so positioned to direct the light on the boards.

Crouse-Hinds Co., Syracuse, N. Y.



#### Service Equipment

A new combination unit designed to solve main switch and distribution panel problems. It provides both service entrance and branch distribution in one unit. There are five different combinations available. The basic units contains

a 100-amp main, fully magnetic circuit breaker, 60-amp range fusible pullout, 30-amp water heater fusible pullout and 12 plug fuse branch circuits. Four other units offered have in addition to above, four and eight extra plug fuse branch circuits; a 30-amp dryer fusible pullout; a dryer pullout and four extra branch circuits. Factory bussing makes units easy to wire. Hook-on-cover uses 2 screws. Designed to fit between building studs, this combination is 12% inches wide. Fusible pull-out construction provides positive electrical contact. One piece fuse clip and blade prevents over-heating.

Murray Manufacturing Corp., 1250 Atlantic Ave., Brooklyn 16, N. Y.



#### Circuit Breaker

"Mini-Breaker" is a new miniature branch circuit breaker that can be installed like a fuse in any standard Edison base fuseholder delivering 110-125 volt ac service. It requires no additional equipment and no rewiring when applied as a direct replacement on existing fuseprotected circuits of corresponding 15. 20 and 30 ampere rating. Anyone can restore electrical service after an overload or short circuit by pressing in and releasing the devices' shock-proof reset button. Although it resembles the fuse, it is a thermally actuated circuit breaker consisting of 25 precision-built parts self-enclosed within a special insulating case. While designed primarily for ordinary residential, commercial, and industrial service, the device meets and exceeds the temperature extreme conditions required for approval for aircraft use. It provides permanent, positive circuit protection. In operation it interrupts excessive overloads and short circuits, tripping instantly on "shorts," but with a built-in time lag to handle temporary starting loads and line surges. It is listed by Underwriters' Laboratories as "Circuit-Breaker-Miscellaneous."

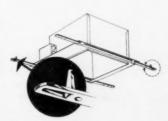
Mechanical Products, Inc., 1824 River St., Jackson, Mich.



#### Circuit Breaker Panelboard

The PB Electri-Center is a general purpose circuit breaker panelboard for controlling lighting and appliance circuits. It is rated 1-phase, 3-wire, solid neutral, 120/208 volt, ac with 100-ampere main wire grips or 3-phase, 4-wire solid neutral, 120/208 volt, ac with 100-ampere main wire grips. It is listed by Underwriters' Laboratories. Available in two sizes, 14 or 20 circuits. They are merchandised as "basic devices", which contains box, interior, two 15-amp pushmatic breakers and two 20-amp pushmatic breakers. Doors with locks are available if desired. They are used in commercial and industrial buildings for controlling and protecting electrical circuits.

Bull Dog Electric Products Company, Detroit 32, Mich.



#### **Mounting Straps**

New Redi-Set mounting strap for use with Pry-Lite recessed lighting fixtures. This Pry-Lite feature makes it easier for one man to install the housing using only a hammer. After inserting the straps the workman taps each Redi-Set prong a couple of times and the housing is fixed in position. They eliminate framing-in and allow housing to be positioned exactly, either before or after straps are attached to ceiling joists.

Pryne and Company, Pomona, Calif.

NEWLY DESIGNED 2003 CONNECTOR:



 Newly designed Thinwall Connectors with 75% more thread to accommodate an insulated bushing, in compliance with the 1951 N. E. C. (Article 373 section 3736-B and Table 4).

Sizes 1"-114"-11/2"-2".

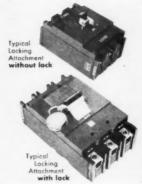
Midwest Electric Mlg. Company



#### Control

A new design of refinery-type limitamp, Class I, Group D, Division 2, which is smaller in physical size. The use of a new manually-operated, oil-immersed, explosion-proof disconnect switch in the primary circuit of control transformer had eliminated the additional cubicle previously required for control power. The single-cabinet limitamp features a vented explosion-proof case in which are housed temperature compensated thermal overloads, time delay undervoltage relay, and low-voltage control power fuse. Other features include a squirrel-cage motor starter for either full- or reduced-voltage starting in a single cabinet; isolation of high voltage and low-voltage circuits by suitable barriers; current limiting fuses for high-voltage power circuit, and for high-voltage and low-voltage sides of control transformer; and disconnect switch in primary circuit of control transformer mechanically interlocked with door to prevent access to high-voltage fuse compartment when fuses are carrying current. It measures approximately 90-in. high, 34-in, wide and 40-in, deep.

General Electric Co., Schenectady 5,



#### Locking Attachment

A complete line of handle locking attachments for circuit breakers. A padlock may be inserted to prevent removal of the safety locking device until the electrician has completed his work on the

(7)

circuit. Devices are also ideal for locking circuit breaker handles in the "On" position on continuous duty circuits such as cmergency lights, alarm systems, clocks, drinking fountains, etc. Protection against accidentally "turning off" circuit is provided while still assuring overload mechanism to operate because of trip-free handle design.

Square D Company, 6060 Rivard Street, Detroit 11, Mich.



#### Thinwall Connector (8)

Redesigned thinwall connector with 75% more thread to accommodate an insulating bushing, available in sizes 1-in, 1½-in, 1½-in, and 2-in. The design change was made to permit compliance with 1931 NEC revision (Art. 373, Sec. 3736-b and Table 4) where bushings are used. This revision requires that ungrounded conductors of No. 4 or larger, entering raceways in cabinets, junction or pull boxes, or auxiliary gutters, shall be protected by a substantial bushing providing a smoothly rounded insulating surface. Photograph compares new design with old style connector.

Midwest Electric Manufacturing Co., 1639 West Walnut St., Chicago 12, 111.



Powr-Rib, a new edgewound-type resistor, designed for high current duty in both intermittent and continuous applications. It offers high heat dissipation, resistance to oxidation, and ability to withstand shock and vibration without breaking or shorting. They are suitable for original equipment or for replacement in existing installations. They are applicable in electric trucks, battery chargers, motor controllers, load banks, plating and welding equipment, as well as motor starting, plugging, field discharge, and dynamic braking in dc controllers. They are wound with a heavy ribbon of resistance alloy on a ceramic insulator. Extra terminals can be ordered for adjustable taps. Available in resistance values from 0.100 to 2.85 ohms. They are rated at 375° C temperature rise on the ribbon. Full-rated capacities range from 18.0 to 108 amperes.

Ohmite Manufacturing Co., 4823 Flournoy St., Chicago, Ill.



#### Wireholders and Brackets (10)

A new line of pipe mounting service wireholders and house brackets. Designed primarily as a supporting means for service entrance conductors on low, ranchtype houses which call for a pipe mast to secure proper ground clearance they have also been adapted widely for other uses. Two point brackets are available in 9 inch and 12 inch spacing and three point brackets are available in 41/2 and 6 inch spacing. Entire series is also available with metal reinforced wireholders. Single point units can be used on 11/4 inch, 11/2 inch, 2 inch and 21/2 inch pipe. The 2 and 3 point units can be used on 2 inch and 21/2 inch pipe.

Porcelain Products, Inc., Findlay, Ohio.

#### Plastic Tape (11)

Panther plastic electrical tape can be used for both electrical and mechanical purposes. Though only 7 mils thick, it will withstand 10,000 volts and has an insulation resistance of over 1,000,000 megohms per 10 square inches of tape. Tape will stand 20 pounds' pull per inch of width without breaking. This new tape adheres to any dry surface even at low temperatures, resists water, oils, chemicals and withstands weather extremes. Available in standard rolls packed in individual cans, five-roll service packs or counter display units. It carries approval of Underwriters' Laboratories, Inc., and complies with established government and commercial specifications.

The Okonite Company, Passaic, N. J.



#### Rubber Connector Body

An unbreakable and shock-proof 2-wire soft rubber cord connector body, especially designed for heavy duty industrial service. It has a metal cord clamp, and is interchangeable with other makes of interlocking devices. All steel parts are coated to resist corrosion. It is listed by Underwriters' Laboratories and is rated 10-amp, 250 volt, and 15-amp, 125 volt. Cord hole diameter is 0.156 to 0.650 and connector has an O.D. of 1½ inches.

Rodale Manufacturing Co., Inc., Emmans, Pa.

(12)

#### TRUSCON PRESSED STEEL INSERTS

...the electrical contractor's answer to the problem of:

anchoring . . . . motors, blowers, transformers, etc. to ceilings, walls and

fastening . . . . electric cables to ceilings and walls or in tunnels and subways.

suspending . . . lighting fixtures from ceilings, walls or columns.

carrying . . . . auxiliary framing which supports the various cables, wires and other instruments in telephone systems.



#### Industrial Lighting Unit (13

A new CFI Day-Line series of industrial lighting units. All-white procelain enamel reflectors are apertured giving a 10% upward light and 90% light distribution downward. Vibration-proof Turret sockets are standard on all models. In continuous runs, the open end gives more light per line. Reflectors fasten to channel by 2-inch captive wing nuts. Open end reflectors available for two or three 40-watt, and two 85-watt fluorescent lamps. Closed end for two or three 40-watt, and two 85-watt fluorescent lamps.

Day-Brite Lighting, Inc., 5411 Bulwer Ave., St. Louis 7, Mo.













ADJUSTABLE INSERTS TAPPED INSERTS
Truscon Pressed Steel Inserts are placed in the
correct, desired position BEFORE the concrete is
poured. Saves time, labor, money. Assures correct
placement of fixtures and easy, quick changes.

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## **HYDEE HANGER**\*





#### Lampholder

(14)

The new Steberlite S-400 accommodates the PAR-56, 100,000 candlepower, 300 watt sealed beam lamp. Streamlined housing is cast aluminum with cooling fins for rapid heat dissipation. Articulated weatherproof adjusting joint for universal aiming. Wiring is fully enclosed and aluminum mounting arm is threaded ½ inch to fit all Steberlite cluster and unit mountings. Available with or without heat-resisting lens. Lamp is held in position by a hinged ring, which permits quick and easy lamp replacement.

Steber Manufacturing Company, Broad-

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . AUGUST. 1952

(15)

Model "JP" ground-ohmer is a new instrument for earth resistance measurements for power circuits and soil investigation. It operates on the potentiometer or drop of potential principle and incorporates an ac magneto generator of the hand cranking type. Balancing method employed offers these advantages: practically no interference from direct or alternating stray currents; accuracy of measurements is not influenced by resistance of test spikes or auxiliary earth; instrument is direct reading in ohms by manipulation of graduated dial of variable resistor; it has three measuring ranges-10, 100 and 1000 ohms. Unit is contained in metal case with plastic top and carry-

Herman H. Sticht Co., 27 Park Place, New York 7, N. V.



#### Connector Body

(16)

A redesign of P&S 7082, three wire polarized cord grip connector body. It incorporates these features; black bakelite body has slots designed to take cap blades readily; extra thick steel armored section and cord grip are bright zinc plated to resist corrosion; long life contacts are accurately positioned and have spring at base, removed from arcing point; tapered wireways and large binding screws. This device has ½- to 9/16-inch cord hole and is rated 15 amps, 125 volts; 10 amps, 250 volts.

Pass & Seymour, Inc., Syracuse 9, N V.

#### Instruments

(17)

Two new instruments, Model 102 circuit tester and Model 247 power circuit analyzer. Model 102, with dc ranges of 1-5-25-125-250-500 volts, 1-10-50 mils, and ac ranges of 5-25-125-250-500 volts, .25-1-5-25 amps, 0-1000 ohms, 0-1 megohm, is for testing signal and alarm circuits, servicing industrial electronic and communication systems, testing motors and lighting loads and maintenance of power systems. It has interlocking pushbutton switching, precision wire-wound resistors, shielded meters and low drain ohmmeter circuits. Model 247, with ranges of 150-300-600 volts, 5-25-125 amps, and 0.6 to 60 kw, is used in locating unbalanced loads; overloaded, underloaded or defective motors; low power factor and excessive circuit voltage drop. May be used on single phase 2 and 3 wire, three phase 3\_wire, three phase 4 wire networks or two phase systems. It has shielded meters; adjustable follow-up

Instrument Laboratories, 315 W. Walton St., Chicago 10, Ill.

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applies to all applicable products manufactured
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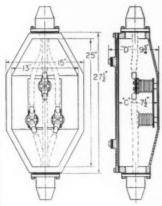


McGill Manufacturing Co., Inc., 450 N. Campbell St., Valparaiso, Indiana

#### cast iron splice boxes







G & W Type "GB" Boxes are designed for splicing armored cables up to 15,000 volts without the use of lead sleeve enclosures. All joints are ground smooth and sealed with "Resistoy!" gaskets. The cable entrances may be wiping sleeve or stuffing box. Internal connections do not require insulating with tape. Conductors are connected by soldered-on lugs, bolted to contacts which are mounted on porcelain supports. The boxes are to be solidly filled with insulating compound. The electrical characteristics are established by the proper length and spacing of the porcelain supports. No particular skill is required for installation.

The Type "GB" Box is also available as a 3 way, 3 pole, 15,000 volt unit.

WRITE OR ASK YOUR LOCAL REPRESENTA-TIVE FOR YOUR COPY OF THE G & W BOX BULLETIN BAS2.





#### Non-Metallic Box (18)

New non-metallic box, 4-inch octagon with bracket, No. 4060-D. With one nail, box can be mounted to joist or stud. "D" bracket boxes eliminate use of bar hangers in all applications where ceiling boxes need not be exactly centered in the ceiling. Box and bracket assembly is so constructed that a fixture stud can be attached from inside the box at any time desired.

Union Insulating Company, Inc., P. O. Box 351, Parkersburg, W. Va.

#### Night Light (19)

When recessed into the wall and mounted approximately two feet above the floor, this incandescent light provides soft illumination. It is for use in hospital rooms, corridors, aisles, stairs, lounges and nurseries. On the exposed tace of the fixture there are five wide louvers diverting a maximum amount of light and with shielding cut-off at the horizontal. Unit is designed for a 25 watt lamp, and with its position in the ver-Since the insert size of the box is only 3 inches deep, it permits installation in very shallow recessing areas. Face trim of unit comes furnished in baked satin aluminum finish. Approved by Underwriters' Laboratories, Inc. Art Metal Company, Cleveland 3, Ohio.

#### Lamps (20)

Two new lamps, one designed for difficult industrial and the other for outdoor lighting, known as the De Luxe Hi-Bay and the Little Giant All Weather Hi-Lite. The Hi-Bay is made in an R-57 bulb. In the 500 watt size, it provides 8000 beam candlepower while the 800 watt produces 14000 beam candlepower. They are designed to provide high intensity lighting for industrial use in working areas where the mounting height is 20, 30 or 40 feet. The Little Giant is a 500 watt Durex all-weather R-40 created to provide high light outrut for general outdoor use. Its hard Durex glass resists sudden temperature changes, moisture, flying insects and vibrations due to wind and weather. It

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . AUGUST, 1952

is designed for such applications as gasoline stations, outdoor floodlighting, used car lots, yard lighting, etc.

Dura-Test Corporation, North Bergen, N. I.

#### Vertical Motors

(21)

A series of single phase vertical hollowshaft motors, types SCU-C and SCU-R. An improved method of disconnecting the starting capacitors has been initiated in this line-the accelerating type relay. To avoid any possibility of bearing grease working into the relay or foreign particles being blown in to the contact points by the ventilating system, the relay was designed into the easily inspected, splittype outlet box located on the side of the motor. Available from 11/2 to 5 hp with speeds of 1800 or 3600 rpm, they offer such features as asbestos protection of windings, Lubriflush lubrication, normalized castings, solid centricast rotor, downdraft ventilation, adjustable hollowshaft, reverse protection clutch and weatherproof housing.

U. S. Electrical Motors, Inc., 200 E. Slauson Ave., Los Angeles 54, Calif.

#### Generators

(22)

A new development in engine-driven electric generators, available without or with engine. Belted construction is designed to make mounting or dismounting of engine a simple matter. To remove engine, unbolt it from its mounting base, drop off the "V"-belt, and engine is then available for other uses such as driving concrete mixers, compressors, pumps, and many other appliances used in industry and agriculture that are engine-powered. When emergency power shortage develops or a portable source of electricity is needed, engine may be re-assembled with generator. Engine mounting base is drilled to receive several popular makes of engines. Units are offered in capacities of 300, 500, 1350, 2500 and 10,000 watts.

Wincharger Corporation, East 7th and Division, Sioux City, Iowa.

#### Transformers

(23)

A new outdoor weatherproof transformer for use with 400-watt type EH-1 and JH-1 mercury vapor lamps. It operates on the Sola constant wattage principle. Constant wattage MV transformer is an outdoor weatherproof unit operating a single lamp. Lamp wattage, lamp current and light output remain constant in spite of variations along a long line circuit. For use in street lighting and defense plant applications, where lamp outages are costly and dangerous. Transformer operates over a range of primary voltage from 100 to 130 volt or 200-260 volt. Case is a flanged two-section, cylindtrical design and is adaptable to wall, pole base or pole top mounting.

Sola Electric Co., 4633 West 16th

As maintenance-free

as a propeller

fan can be!

RUGGED CAST FRAME KEEPS WORKING PARTS ALIGNED FOR DECADES

NO BELTS TO STRETCH, WEAR OUT, NEED REPLACING

NO PULLEYS TO WASTE POWER, GET OUT OF ALIGNMENT

SELF-COOLED MOTOR NEVER "GUMS-UP"

ILG-BUILT MOTOR NEVER NEEDS LUBRICATION

PATENTED ILG FAN BLADES DELIVER MORE AIR QUIETLY, WITH GREATER EFFICIENCY

### ILG direct drive ends noise and trouble

· Here's the propeller fan that's practically maintenance-free over decades of service. Mounting of fan blade directly onto motor drive shaft, plus a rugged cast frame, keeps working parts in perfect alignment. Nothing can get out of order to cause objectionable noise, inefficient operation, or rapid wear. There are no belts to replace, no pulleys to adjust. The patented ILG-built motor has double-sealed, permanently lubricated ball bearings-and it's specifically designed with a self-cooling feature for exhaust fan duty. The motor stays clean, cools itself-no foul air reaches it to interrupt service, shorten its life. You get the low operating cost of an open-type motor with the protection of a fullyenclosed motor. Get complete data now on the fan you can install and forget. Send coupon or phone our nearby Branch Office (consult classified directory).



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SYNTRON CO.

Homer City, Pa





#### Receptacle

(24)

A new double-contact, T-slot receptacle design which provides a positive, locked-wire connection. Named "ChanneLock," it has a serrated channel stamped under the head of each terminal screw. This permits the installation electrician to insert stripped wire into channel and tighten the terminal screw. Sharp edges of the serration grip wire and prevent it from pulling out. Available in brown and ivory, with and without plaster ears.

ivory, with and without plaster ears.

Slater Electric and Mfg. Co., Inc.,
Woodside, New York

#### Weatherproof Switch

(25)

A new weather and oil-proof pushbutton electric switch. Weighing only an ounce, the double-pole, double throw assembly is so small it will fit inside a walnut shell. Panel-mounted pushbutton is sealed against entrance of oil, water and dirt by synthetic sponge rubber. Small movement required to operate subminiature snap-acting switches is provided by resilience of seal. No sliding joints are required. Underwriters' Laboratories list both single and double pole switch assemblies for 5 amperes 250 volts, ac, and either type will control 30 volts de inductive loads of 2 amps at sea level, and 11/2 amps at 50,000 feet elevation.

Micro Switch, Freeport, Ill.

#### Screw Anchor

(26)

A new screw anchor that is easily installed and provides increased anchorage strength and resistance to vibration. It can be used wherever machine screws, stove bolts or wood screws must find an anchor in brick or masonry. It provides solid anchorage, prevents loosening and pulling out. Features are a threaded insert, lead sleeve and cup-shaped fluted steel anchor. When driven into place, the lead mushrooms out and then the steel anchor collapses, forcing sharp edges into the masonry and the threaded component. A tamping tool is used to mushroom the lead sleeve and flatten the steel anchor. A blow tube is also provided that is inserted into the masonry hole to remove all dust and dirt.

Super-Grip Anchor Bolt Co., Inc., 3333 N. 22d St., Philadelphia 40, Pa.

#### Infra-Red Oven

A new roller tray infra-red oven that gives conveyorized production without conveyor equipment. These ovens are ideally suited for the production of small parts and medium production of larger sized parts. Also to baking of synthetic enamels and lacquer finishes, and drying of electroplated parts. Asbestos insulated construction, together with heat conserving baffles at the oven entrance guarantee maximum production efficiency. sockets are wired with asbestos wire, and each channel row is equipped with a toggle switch for individual control switching. Size of oven can be increased at any time by adding additional oven sections. Standard oven lengths are 24, 32, 48 and 96 inches. Tray is constructed with steel wheels having ball bearings for easy rolling.

Wil-Son Mfg. Co., Cloverpart, Ky.



#### Receptacle

(28)

(27)

P&S 7310, three-wire Turnlok re-ceptacle incorporates these features; solid bakelite, 2-piece construction (no laminated parts), extra heavy long-life contacts, separately enclosed (sides, top and bottom) in separate chambers, eliminating leakage from points of opposite polarity. Pressure type terminals designed for either side or back-wiring; handy strip gauge on back for convenience in back-wiring; plaster ears. Rating is 20-ampere.

Pass & Seymour, Inc., Syracuse 9,

#### **Fixture Hanger**

A new explosion-proof fixture hanger, meeting the requirements of writers' Laboratories, and the National Electrical Code. Type EFHC is essentially a T fitting, the top two throughfeed hubs for the lighting circuit conduit and the bottom hub for the fixture stem. A threaded cover is provided at the side of the hanger so that it faces the installing electrician. The fixture with stem and connecting wires can be assembled on the bench. The fixture stem may be threaded into the bottom hub of the hanger without the risk of twisting the connecting wires before connection is made to the circuit wires. A connection block is available for connecting the fixture wires to the circuit wires by means of two double terminals, or the wires may be spliced in the normal manner. Available with either plain hub or union hub for fixture stem. Both types of hubs are provided with set screws to prevent fixture stem loosening from vibration.

Crouse-Hinds Company, Syracuse,



Latest RAMSET System development adds new ease, speed, utility and economy for most fastening jobs in steel and concrete.

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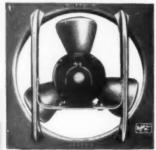
- 1. One-Piece Tool opens fast for easy loading.
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- 4. Gas Diverter more consistent penetration-protection to work surface.
- 5. Angle-Fire Control-to assure perpendicular penetration.
- 6. Manual Safety Controllocks tool into inoperative position.
- 7. Finger-Grip Handle-firm holding with comfort.
- 8. Neeprene Grip-fitted to the hand.
- 9. Barrel Extension in handle for quick use.
- 10. Roto-Set Safety Shieldfor easy, accurate positioning.

Product Patent No. 2470117. Other Patents Pending.



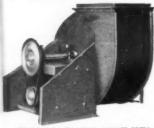
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#### Floor Boxes

Adjustable watertight floor boxes are now equipped with a positive electrical bonding system, conforming to Underwriters' Laboratories specifications. One terminal of an insulated 14-strand copper cone is attached to the bottom of the box, and the other may be attached to the cover. Once the box is installed, the wire cannot come in contact with the exposed receptacle terminal screws inside the box. Box complies with the National Electrical Code and is fire-proof.

(30)

Fullman Manufacturing Co., Latrobe, Pa.

#### Ballasts (31)

New "Dynatran" ballast for lead-lag operation of instant-start hot cathode fluorescent lamps. Two models are available: Catalog No. 628-408 for 2-96T12 slimline lamps, and No. 624-408 for 2-48T12 slimline lamps. Ballast is certified by Electrical Testing Laboratories. It provides independent lamp operation; small size; high starting current; fast lamp starting; low wattage loss; low peak to rms current ration; more lumens per watt; cool operation and low temperature rise; ventilated capacitor compartment; and stroboscopic correction.

Sola Electric Co., 4633 West 16th Street, Chicago 50, Ill.

#### Incandescent Light (32)

Two new recessed, incandescent lights, for wet or moisture-laden locations. They are for use in showers, bathrooms, porches, stoops and marquees, etc. Fixture is designed so that a moisture-proof cork gasket is placed between the glass and face trim, and between face trim and insert housing. The white ceramic glass has high light transmission efficiency and is scientifically contoured for uniformly white surface brightness and spread light on ceiling. Face trim and insert housing are made of corrosionproof aluminum. Units are styled for either a 60 or 100 watt IF, lamp, and approved by Underwriters' Laboratories,

Art Metal Company, Cleveland, 3. Ohio.

#### Voltage-Measuring Reactor (33)

A new de voltage-measuring reactor, to provide increased safety in the measurement of de voltage by insulating the instrument circuit from the power source. Developed for remote measurements of de voltages up to 1200 volts, the equipment consists of a saturable core reactor with a single de winding, two ac windings, and proper range resistors. The de winding has a saturating effect on the core, and the ac windings, supplied from a separate power source, deliver a rectified average current proportional



to the degree of saturation of the core. A selenium bridge rectifier is used in the ac circuit to permit interpretation of the average current. A calibrating adjustment is provided.

General Electric Co., Schenectady,

#### Plastic Electrical Tape (34)

A new plastic electrical tape that is particularly adapted to heavy duty work, winding heavy cables, electrical harnesses and for use with power driven taping machines. The tape is .010 inch thick, has great strength and flexibility and is resistant to weather, oils, acids, alkalies and corrosive chemicals. Dielectric strength averages 10,000 volts (1000 volts per mil of thickness) and because of its ability to stretch, it conforms well to irregular surfaces.

Van Cleef Bros., Inc., 7800 Woodlawn Ive., Chicago 10, Ill.

#### Floodlights (35)

Three new series of floodlights, engineered primarily for sports lighting. All units are designed for 1500 watt lamps, and are designated as Series "A", "W" and "Y". They are furnished in both open and enclosed weatherproof types. Forty combinations of mounting and beam spreads can be achieved. Series "A" units feature aluminum housings and lens rings, heat resistant lenses, polished and plated reflectors. Narrow, medium and wide beam spreads available. Series "W" afford same efficiency lightingwise as Series "A", with simpler construction of mounting bracket and lens ring. Series 'Y" are designed where minimum floodlighting standards are permissible. Reflector is matte finish plated for wide angle distribution and high reflectance. Four types of mounting is available on all models.

The Spero Electric Corporation, 18222 Lanken Ave., Cleveland 19, Ohio.

#### Circuit Breaker Panelboard (36)

The XD Electri-Center is a circuit breaker panelboard with split bus bars, and is used for controlling and protecting lighting and light duty motor circuits. The main bus bars are split so

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Industries that have converted to Westinghouse Slimline Fluorescent Lighting Systems have evidence of definite economic advantages:

- Fewer lamps to replace. It takes half as many lamps and fixtures for the same high level of lighting.
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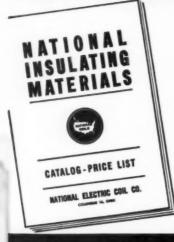


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that they feed two separate sections or groups of pushmatic circuit breakers. The circuit breakers in the upper section serve as "Main Disconnects" and those in the lower section as general "Branch Lighting" circuits. The service line cables are connected to the bus bars in the upper section. Two 50-amp pushmatic circuit breakers in the upper section (connected with a two pole tie handle) feed the lower bus bars, acting as a main breaker for the lighting section. Listed by Underwriter's Laboratories. Panels come in two sizes, 12 or 18 circuits, each with either flush or surface fronts. They are rated single phase, three wire, 129/240 volt, ac, with 100-amp main wire grips.

BullDog Electric Products Company, Detroit 32, Mich.



#### Transformers

(37)

Two types of 1000 watt mercury transformers—one for the operation of H-12 lamp, and the other for H-15 lamp. Each line includes transformers for operation on 115, 230 and 460 volt circuits. Core and coil assemblies are impregnated with a polymerizing varnish and baked for protection against moisture. Designed with a large wiring compartment, one-half and three-quarter inch knockouts, color coded and tagged leads and sturdy mounting brackets. Three line matching voltage taps are provided.

Jefferson Electric Co., Bellwood, Ill.

#### Intercommunication System (38)

A new Talk-A-Phone "job-fitted" intercommunications system, with 11 optional features designed so that a single system may be adapted to any specific requirement from a simple interoffice system to the most elaborate industrial layout. Optional equipment offers each of 11 exclusive developments including busy signal; Redipower; dynasonic performance; multimagic selector; privacy handset; earphone; right-of-way relay; hold-a-matic pushbuttons, silent touch bar; uni-trans and conference features. Units can be delivered to include all of these features. or any combination required. Units can be made to take care of complicated or multiple needs, ranging from "private" calls to conference, private and non-private, paging and remote use. More units and features may be added as needed, without obsoleting original equipment.

Talk-A-Phone Co., 1512 So. Pulaski,

#### Fluorescent Lamp

A new type of 40-watt fluorescent lamp named "Rapid Start". They are to be used with especially designed ballasts, and are intended only for new lighting systems. Made in the 40-watt size and in the "standard cool white" color. In a "Rapid Start" lighting system, all lamps controlled by one switch will light promptly. Lamps will not blink or flicker. Lamps operate in series, two on one ballast. Lamps employ a complex, triple-coiled cathode, that part of a fluorescent lamp which serves to conduct electricity from the wires to the gas. They also employ a water-repellent coating to insure starting

under high-humidity conditions. General Electric Co., Nela Park, Cleveland 12, Ohio.

#### **Transformers**

(40)

(39)

A new line of Class "B" insulated, aircooled transformers for general light and power service, ranging in size from 3 to 50 kva. Designed in accordance with NEMA specifications, these single-phase, 50 or 60 cycle transformers have "dualvoltage" primary and secondary windings in two sections, arranged for either series or multiple connection. Voltages range from 485 to 110. They are encased in louvred steel enclosures.

Transformer Division, Precision Welder Mfg. Co., 660 West Grand Ave., Chicago 10, Ill.

#### Motor (41)

Single phase variable speed motors in fractional horsepower. New motor permits use of 110 or 220 volts. It is designated as Type VA-C Varidrive and is made in 1/4, 1/3, 1/2 and 3/4 hp. Motor provides speeds in a 10:1 ratio with the range from 4 to 10,000 rpm. By turning a control dial, motor's speed can be instantly changed to a desired speed without stop-

U. S. Electrical Motors, Inc., Box 2058, Los Angeles 54, Calif.

(42)



FLUORESCENT LUMINAIRE called the Lexington. Available in 2 and 4 lamp, 4 and 8 foot types for general and slimline lamps. Unit has 45° lengthwise and 35° crosswise shielding with low brightness. Rigid steel construction. Choice of metal, plastic and glass panel sides. Manufactured by the Miller Company, Meriden, Conn.



"Latrobe" Floor Boxes and Wiring Specialties are designed to do their job easily and surely with no excess parts. This same compactness of design makes for fast, easy installations.



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Tes, quickly make bends exactly as you want them, when you want them, where you want them, where you want them. Compact, portable Greenver Hydraulic Pipe and Conduit Bender lets you do this in a jiffy. One-man operated to produce smooth, accurate bends in just a few minutes... in pipe up to 5°, rigid and thin-wall conduit, tubing, bus-bars. Owners report timesavings up to 60% and more, elimination of cost for manufactured bends and fittings, and "clean", tailor-made installations every time. Get facts now on this time-saving tool that often pays for itself on first few jobs! Write for free Bender Booklet. Greenlee Tool Co., 1748 Colum-



bia Avenue, Rockford, Illinois.

Other GREENLEE timesaving tools for electrical works Hand Benders, Joist Borers, Cable Pullers, Knockout Tools, Auger Bits and Drills.



#### Electric Insect Trap

An electrically operated trap, called the "Killer-Kage", to electrocute corn borer moths, cotton boll worm moths and other destructive insects. It is an assembled and factory wired unit including steel pole mounting bracket. Moths are attracted to trap by four 300-watt lamps mounted behind a wire grid which is energized by a 7500 volt 18 ma transformer. In attempting to reach the light source, moths are instantly electrocuted.

(43)

Steher Manufacturing Co., Broadview, Ill.

#### **Product Briefs**

(44) W. N. Matthews Corp., St. Louis, Mo. has developed a new Protectolink cutout. . . . (45) Meric Chemical Company, Chicago, Ill., has announced a new anti-static compound No. 79 to remove static charges on polystyrene luminaire panels; plastic lamps and fixtures, and electrical parts. . . . . (46) A new phase sequence relay has been introduced by the Shepard Elevator Co. of Cincinnati, Ohio.

(47) The Stacor Equipment Company, Brooklyn, N. Y., has developed a 4-post tracing table featuring scientifically designed fluorescent reflector. . . . (48) A new series of heater switches has been developed by the Hart Manufacturing Co., Hartford. Conn. . . (49) Newly designed Honeywell mercury switches, embedded in plastic "potting" compounds for added protection, have been announced by Micro Switch of Freeport, Ill.

(50) Cannon Electric Co., Los Angeeles, Calif., has introduced a new line of heavy-duty plugs and receptacles based on U. S. Army Ordnance specifications. . . . (51) A waterproof, snap-action switch incorporating potted, waterproof terminal leads and a hermetically sealed contact chamber has been announced by Micro Switch, Freeport, Ill. . . (52) The Kuhlman Electric Company, Bay City, Mich., has incorporated in its transformers its redesigned "Quick-Grip" bushing.

(53) The Justrite Manufacturing Co., Chicago, Ill., has introduced a new safety red flashing lantern for use in all Class I, Group D hazardous locations as well as other spots requiring

a warning or marking light. . . . (54) A new device for measuring torque transmitted through small instrument ball-bearings under thrust loads, has been announced by General Electric Co., Schenectady, N. Y. . . . (55) Terado Company, St. Paul, Minn., bas announced a new hermetically sealed miniature relay.

(56) Jagiel Manufacturing Co., Swanton, Ohio, has introduced an iron pipe scaffold that can be erected to any height or width to suit all construction jobs. . . . (57) A new line of outdoor power circuit breakers for distribution and sub-transmission applications has been announced by the General Electric Co., Schenectady, N. Y. . . . (58) A new three-in-one toggle bolt assembly is being offered by the Super-Grip Anchor Bolt Co., Inc., Philadelphia, Pa.

(59) Lander & Abbott, La Crescenta, Calif., has introduced a new tool, known as Metalmitre, for on-the-job mitering of metals. . . . (60) A new line of portable electric drills, designed to meet all production line requirements has been introduced by the Mall Tool Company, Chicago, Ill. . . . (61) Loomis Industries, Berkeley, Calif., has announced a new drafting instrument known as Paraline, which provides a T-square, straight edge, triangle, protractor, 1/32nd inch scale, and parallel rules.

(62) A new demountable scaffold end frame that may be disassembled and passed through small openings for scaffold erection in water tanks, oil tanks, blast furnaces, boiler and similar jobs where entrance space is limited, has been developed by Wilson-Albrecht Co., Inc., Minneapolis, Minn., (63) Empire Development Corp., Huntsville, Ala, has announced a new Draw-In-Dex upright filing cabinet, for the filing of blueprints, tracings, drawings, photographs, etc., (64) Radio City Products Co., Inc., New York, N. Y. has developed a midget-scope, Model 533M, which is a miniaturized professional oscilloscope.

(65) Westinghouse Electric Corporation, Pittsburgh 30, Pa., has announced a new engine-driven welder. Type EW-20. (66) Polytetra-fluorethylene electrical insulating film in a versatile new form that can be fused into a coherent mass after application has been announced by Minnesota Mining and Manufacturing Co., St. Paul, Minn. (67) Photoswitch Incorporated, Cambridge, Mass., has introduced a new electronic timer Type 30H.Ll.

(68) A new Bi-Seal self-bonding insulating tape is being manufactured by the Bishop Manufacturing Corp., Cedar Grove, N. J. . . . (69) A new portable mining machine cable which reduces the chance of shock hazard and arcing when a break occurs, has been developed by Anaconda Wire & Cable Co., New York, N. Y. . . . (70) General Control Company, Boston, Mass., has developed a new promatic electronic timer.

Skylike blends 2 types 1. the soft, indirect light of silvered-bowl incandescent lamps. 2. the sleek, modern look of of lighting units fluorescent-type troffers. into

Silvray SKYLIKE lighting offers advantages found in no other system, yet uses only silveredbowl incandescent lamps,

Designed along modular concepts for recessed or semi-recessed use, SKYLIKE fixtures may also be surface-mounted in old or remodeled interiors without sacrifice in lighting quality.

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Here's real proof of SKYLIKE efficiency . . . unretouched photographs demonstrate the versatility of the SKYLIKE louvered incandescent lighting system. In each case, the only light cal in initial cost - only 1/2 to 1/3 as much as other equipment delivering comparable results. Ease of maintenance permits similar savings - units can be relamped from the floor and require only an occasional cleaning with a damp cloth.

SKYLIKE fixtures fit 24" x 24" ceiling tile . . . are light in weight, easy-to-handle, and require only minimum framing support.

source used was that of the SKYLIKE units note the soft, even distribution of light . . . the complete absence of glare, harsh shadows, and sharp light cut-off lines.



Photo by Milton Mann Studios

A unique SKYLIKE application is pictured here in the showroom of Irving A. Belking Furs in San Francisco, California. Notice how architect Bernard J. Saboroff's gridwork of 1 x 6 pine serves

to hide the unsightly high ceiling, as well as to support the patterned group of recessed Silvray SKYLIKE units. Low brightness levels and 90° shielding provide an extremely satisfactory result.



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### CATALOGSand BULLETINS

- (71) FIXTURE HANGERS for disconnecting and lowering lighting fixtures are described in 8-page illustrated bulletin TH-52, including engineering drawings and photographs of indoor and outdoor applications, data on the construction, maintenance and operation of the unit and its accessories. The Thompson Electric Co.
- (72) TRANSFORMER CORE and coils replacement assemblies for substituting or increasing the ratings of old or service-damaged transformers (tank size permitting) are illustrated and described in bulletin 61B6345A, with installation data and specifications on the factory-tested assemblies which conform to NEMA standards. Allis-Chalmers Mfg. Co.
- (73) CONNECTORS for aluminum building wire are illustrated and described in catalog AL-54, including technical details on the units and wiring data, and a step-by-step procedure for proper installation of the connectors and aluminum conductors. Burndy Engineering Co., Inc.
- (74) INDUSTRIAL LIGHTING is the subject of 96-page handbook, covering engineering data on principles and economics of lighting in specific indoor and outdoor industrial areas, with detailed explanation of the equipment needed and its application. Holophane Co., Inc.
- (75) PANELBOARDS up to 42 circuits, assembled from five basic devices-interior, box, front, breakers and filler plates-are illustrated and described in bulletin 513. Bulldog Electric Products
- (76) CEILING FIXTURES, square and round recessed units with lens, louver or pinhole aperture and albalite or formed glass, are illustrated and described in 15-page booklet, including photographs, construction sketches, specifications, footcandles charts and curves, and application information. Lightolier, Inc.
- (77) CASE HISTORIES on over 100 motors are presented in 35-page booklet, including actual applications of motors in the chemical, textile, petroleum, lumber, metalworking, paper, food, mining and machine and production tool industries. Westinghouse Electric Corp.
- (78) ELECTRICAL PRODUCTS wiring harnesses and assemblies, cord sets,

accessory wiring equipment, waterproofed toggle switches, sealed enclosures for relays and other controls, molded waterproof junction blocks, junction boxes, rubber molded sockets, and other specialties-are illustrated and described in 4-page bulletin. Riverside Mfg. and Electrical Supply Co.

(79) AIR CONDITIONING catalog contains 60-pages of full and complete illustrated information on air conditioning, cleaning and handling, covering description and specifications of equipment, application data and technical data with a selection chart for meeting job requirements. Westinghouse Electric Corp.

(80) CONTROL ALTERNATORS for automatically changing starting sequence on 3-4-6-12 pumps, blowers, compressors, burners and other units controlled by magnetic starters or two-wire circuits are illustrated and described with data on the construction, design, specifications, operation and application and wiring diagrams showing relation to controlled switches. Automatic Control Co.

(81) LIGHTING FIXTURES, slimline fluorescent units for service station lighting, are described in illustrated bulletin, including construction and installation data, mounting details, number and type of lamps, and footcandles readings. Guardian Light Co.

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(84) FIXTURE CATALOG contains illustrated description and technical data on a complete line of fluorescent lighting fixtures, including commercial and industrial units, surface and suspended types, and special units. Leader Electric Co.

(85) VOLTAGE TESTERS and circuit testers are illustrated and described in literature covering the application, operation and ratings of the several twopart hand testers. Sittler Corp.

(86) INSULATING TAPE and its application to wire and cable splices is the subject of bulletin B-100, covering the



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electrical characteristics of the selfbonding tape. The Bishop Mig. Corp.

(87) ELECTRICAL SPECIALTIES are specified and described in 26-page illustrated catalog, including construction details on hundreds of standard sizes of outlet boxes and fittings, junction and pull boxes, hinged cabinets, terminal boxes and explosion housings, with data on custom modifications on standard boxes. Hope Electrical Products Co., Inc.

(88) Wiring Devices, adjustable watertight floor box, pipe and conduit hangers, junction boxes, nozzle with cover plate, two gang box and other specialties are illustrated and described in bulletin. Fullman Mfg. Co.

(89) Time Switch for control applications where it is desired to skip operation of the time switch on selected days is illustrated and specified in catalog TS-31 insert. International Register Co.

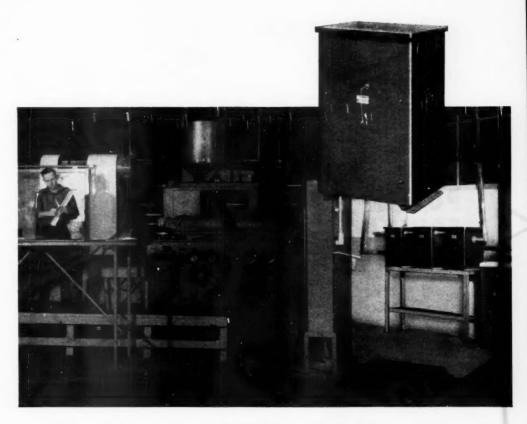
(90) FASTENING TOOLS, fasteners, fastening charges and accessories are illustrated and described in specification booklet on powder-actuated fastening system. Ramset Fasteners Inc.

(91) LIGHTING CATALOG contains a wealth of technical lighting data on fluorescent applications, fluorescent fixtures with downlights, construction of luminaires, performance tests and curves and tabulated data on many actual lighting installations in commercial and industrial areas. Northern Light Co.

(92) FANS for home, commercial and industrial use are illustrated and described in catalog, including pedestal and floor fans, portable window fans, reversible and non-reversible, shutter-attached vent fans, kitchen fans and panel ventilating fans. Signal Electric Mfg. Co.

(93) SOLDERLESS CONNECTORS, cable and conduit fittings and wiring devices are illustrated and described in Catalog 52, including specifications and application data on wire splicing and terminating, insulated conduit bushings, box connectors for non-netallic sheathed cables, conduit lock-nuts, knockout plugs, etc. Buchanan Electrical Products Corp.

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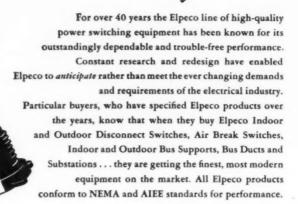
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### Reader's Quiz

#### **Plugging Switch**

QUESTION A-21: I was recently called in to do a job on a plugging switch and there was some difficulty there that possibly some of your readers could advise on. In connection with the use of a plugging switch on a 5 hp motor, in order to stop the motor instantly at a given position, it was found that the motor had a tendency to reverse after the plugging switch was depressed. Is there any simple way to remedy this? What was finally done was to add a brake to the machine to add friction, but this does not appear to be a very good solution as power is being used for nothing merely to overcome the brake friction .- H.H.S.

ANSWER TO A-21: The same condition occurred at our plant. We have a number of plugging switches operating, but two of them continued to have a slight reversing effect. I noticed that all the plugging switches were operating on 1160 rpm motors, except two which were 1750 rpm. The desired braking effect was finally obtained by removing the drag magnets, a pair at a time, on the 1750 rpm motor.—C.W.D.

ANSWER TO A-21: The setup I have used is as follows: Use two magnetic contactors or a reversing type. First contactor to operate motor is a timer which starts unit and operates it for timed interval. Upon completion of operation, timer opens coil circuit of first contactor, which removes energy to motor, then timer closes set of points which closes plugging contactor through a switch mounted on end of motor shaft. These switch contacts are in series with second set of timer points to plugging contactor coil circuit. They are normally open when motor is at stand still and close on first operation due to rotation, then open when motor stops, thus preventing counter rotation. If H.H.S. does not require plugging and still needs quick stop, why not use a good Mechanical Elecbrake which is removed when current is on motor and comes on when current is removed.-J.B.D.

ANSWER TO A-21: The fact the motor tends to reverse when plugged indicates that it is too large for the

load. A smaller motor would plug properly and provide more economical service, as efficiency and power factor are poor in underloaded motors. If this is not possible, and it may not be if the load is variable, a magnetic brake could be applied which will act during plugging but will not retard it during normal operation.—D.H.N.

#### **Electric Water Heater**

OUESTION B-21: We have an 80 gallon electric hot-water heater that had the elements burned out because the water was drained out of the tank before turning off the current. The switch supplying current to the heater was located at the heater but the draining was done under the floor and the switch overlooked. Could a pressure switch be installed on the water heater or piping so that it would open up the electric service to the heater if the water was drained out or if the water level got below the level required to keep the element submerged?-E.E.M.

ANSWER TO B-21: A simple and effective way to prevent electric heating elements from burning out or developing excessive outside sheath temperatures, is to install a thermostat on the heating element. This could be connected to the power supply to the heater and if low liquid level should cause the element sheath temperature to rise excessively, it would automatically shut off the power to the heater. I have used this successfully on small electrically heated de-greasers where excessive evaporation of solvent exposed the heating element. Signaling devices, such as pilot lights or alarms, could be incorporated to notify the operator when the high temperature is reached.-R.E.B.

ANSWER TO B-21: Addition of pressure switch will partly solve this problem. However, it should be serieswired with suitable thermostat so water temperature would always be controlled. Pressure switch should be installed at far end from discharge so any peak service demand will not cause constant on-off operation. Tank installation should be reversed so heating

elements will be at bottom instead of top which will give automatic water coverage of elements at all times. This will also give increased heat transfer as heat will rise upwards through water from the lower to top of tank heater.—L.W.F.

ANSWER TO B-21: In my experience with plating room tanks of about the same size, they are used for plating, anodizing, dichromate, sulphuric acid, copper strip and many more applications. These tanks are controlled by an indicating temperature control thermostat which emerges the contactor which supplies current to the monel heater, stainless steel heaters, or monel-lead-lined heaters (whichever type you have). All these tanks should be protected with a low liquid level shut-off, with a float switch. If the level of the liquid should be low or should the tank be drained and the power switch is forgotten this float switch will cut the controlling circuit open and the main contactor will not be energized. This float switch can be a brass cylindrical with both ends capped, with a shaft or rod from one end. The rod can be 1/3 the depth of the tank. It will float within a larger pipe so that it would not interfere with the work in the tank. Upon the rod are two collars which are set for allowable low liquid level and should the liquid be drained the top collar will trip the switch which is connected in the holding circuit of the contactor. When the level is brought up to capacity of the tank the switch is depressed by the lower collar on the rod, and the circuit is completed with the contactor in service to your tank heaters .- O.C.

#### **Heating Cable**

QUESTION C-21: How can I install heating cable to melt the ice from eaves and downspouts and yet protect the eaves and downspouts from galvanic action due to contact with the lead of the heating cable?—H.S.

ANSWER TO C-21: In our vicinity many residents use heating cable to keep the ice open on eaves of buildings. Those who have gutters and down-

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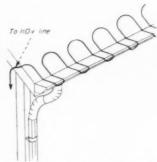
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spouts do not try to keep them open as they would freeze at the lower end beyond reach of the cable. We usually arrange the cable as shown in the sketch. The lead cover on the cable does not carry any current so there is no galvanic action. The cable is laid zig-zag along the edge of the roof overlapping the gutter and 8 or 10 inches of the roof edge. The cable must lang at least one inch beyond the edge of the gutter. This keeps a number of openings clear so the water can run off.—E.E.M.

ANSWER TO C-21: You can successfully use heating cables around caves and downspouts by the use of the non-leaded types of heating cables. These have a heat resistant water resistant covering of rubber of a special grade that will withstand the conditions, yet present no galvanic action problems. Several of the manufacturers of heating cables offer this type of cable.—L.R.B.

#### **Cleaning Motor Windings**

QUESTION D-21: What precautions are necessary in cleaning and impregnating silicone insulated motor windings?—D.H.N.

ANSWER TO D-21: Today's improved scrape abrasion resistance of silicone bonded wire equals that of the best organic bonded wire, which substantially reduces the former tedious care and time required for silicone winding operations. Air is still the best winding cleaner at about 50 psi. The stator is then given two dips of silicone varnish and baked for at least twelve hours in an oven at a temperature of 150° to 250° F. A second dip. usually eight to ten hours, is recommended with over temperatures gradually increasing from 300 to 450°F. Frames and end bells should be finished with a cadmolith silicone paint. Being heat stable, this enamel, is cured during the second or final bake. -L.W.F.

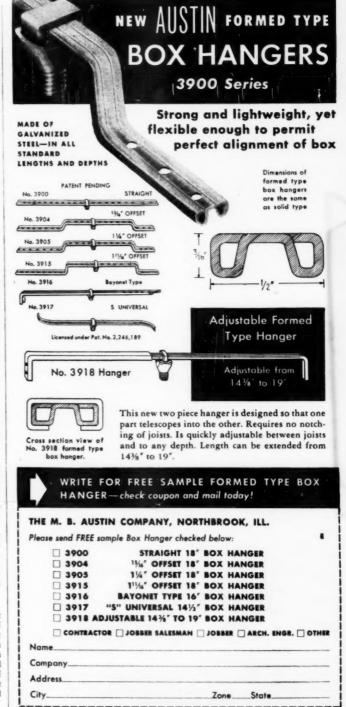
#### Synchronous Motor

QUESTION E-21: We have a 600 hp 2300 volts synchronous motor, at 240 rpm. When starting these motors, auto-transformer starting, with discharge resistors across the field, sparks jump between field coils. Does this mean there is something wrong with our field coils or is that just a natural condition? The field does not show any ground.—A.T.

ANSWER TO E-21: The reason why a discharge resistor is connected across the field of synchronous motors is to prevent a high voltage from being induced in the field coils when starting the motor. Sparks jumping across the field mean a loose connection or a point of high resistance at the points of sparking.—J.L.C.

ANSWER TO E-21: Field coil insulation could be damaged due to overvoltage, voltage transients and high induced voltages. Moisture, dirt and fumes, overheating and carbonizing with excess vibration and shock could have caused coil movement damaging insulation giving leakage and possibly damaged connecting wires. Carefully check coils and resistors for present ratings. With this type starting, initial starting torque is reduced and proportional to starting kva and lowest transformer tap should be used which will give sufficient torque to start motor. When the current is transferred from reduced to full voltage, the accompanying transient current causes a sudden severe voltage disturbance and surge. Since with manual starting the field switch is closed by hand, the timing being a matter of operator's judgment, the field circuit must be closed when the rotor approaches synchronism so that it will pull in step. When starting automatically, timing relays close field circuit at proper moment to give maximum pull-in torque. Even though a synchronous motor is not driving any load, it is possible to overload stator windings with ac by over-exciting the de field and thus cause the motor to draw a large leading current. The current input should never exceed nameplate rating or manufacturer's recommendation in starting under any load condition .- L.W.F.

ANSWER TO E-21: This means that the discharge resistors are open or of too high a resistance value. Most synchronous motors are started as an induction motor. This results in a high voltage being generated in the field coils, unless a well designed set of spark gaps or a discharge resistor limit this voltage to the value that the field coils can handle.—H.S.





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Threading Time	11 sec.	14 sec.	15 sec.	18 sec.	
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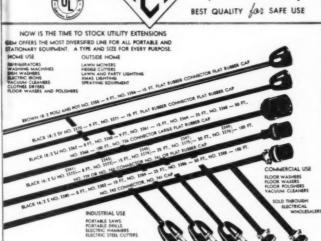
Pipe	3/4" 2 sec.	1" 4 sec.	1 1/2 " 8 sec.	
Tubing	1/2 sec.		2" 4 sec.	3" 6 sec.

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QUESTION \$21-We have in service in our plant quite a number of General Electric Stall reversible motors rated at 40 ounce inches, 115 volts, single phase, 60 cycles. These motors have a 96 pole permanent magnet rotor and run back and forth between two mechanical stops. The impact of hitting this stop reverses the motor. Frequently the action is erratic and the motor will reverse before it hits the stop although there is no mechanical tightness. I would like some theoretical or practical information about this type of motor.-H.P.H.

QUESTION T21-After repairing a 3 phase, 23,000 volt primary, 2300 volt secondary transformer, I find that by applying a no load current on the secondary taps, that two of the phases or transformers, delta connected, draw one ampere, checked individually, but the third phase or transformer draws only one-half ampere. Why is this? The ratio in voltage checks out the same on all phases or transformers. -E.S.H.

QUESTION U21-We generate our own electricity and direct current for use when plant force is at work. Our light circuits are powered by dc during work period and by purchased ac during non-working hours. We have many de motors that are plugged into the light circuit, which are supposed to be disconnected before ac is used. Many are forgotten and the result is burned out motors. Is there any electrical device that would break the circuit whenever ac is used on a de motor?-A.S.J.

QUESTION V21-I recently rewound two identical 110 volt single phase, 60 cycle, 1750 rpm, capacitor start motors, using the original factory data on the windings. In rewinding, on the first stator, I laid down the starting winding on the bottom, and the running winding on top, as the manufacturer did, and the motor tested fine. In the second stator, I laid the starting winding on top of the running winding, instead of under the running winding as the factory had done, and I discovered that a heavier capacitor had to be used to make the motor pull its starting load under test. Why? -J.S.W.

QUESTION W21-How can I check the starting current of an electrical chime? The running current will not throw the plunger far enough. H.S.

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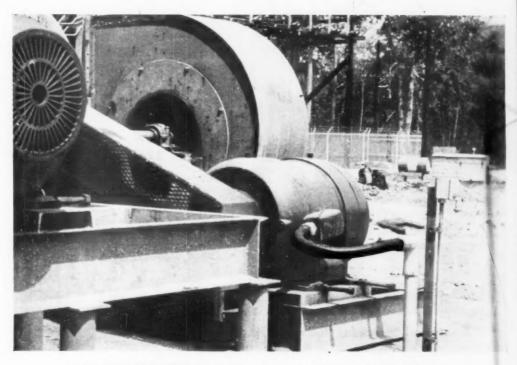
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### Questions on the Code

Answered by

B. A. McDONALD, New York Board of Fire Underwriters, Rochester, N. Y.

GLENN ROWELL, Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.

B. Z. SEGALL, Consulting Electric Engineer, New Orleans, La.

F. N. M. SOUIRES, New York Board of Fire Underwriters, New York, N. Y.

#### **Motor Starter**

L have just been refused permission to use an oil immersed notor starter in the pump room of a petroleum bulk plant which handles various petroleum products, including gasoline. It is my contention that inasmuch as no open handling of flammable liquids is found within this pump room and they are normally enclosed within piping or vaportight enclosures, the area strictly should be defined as a Class I, Division 2 location. Am I correct in this assumption!—A.N.S.

Theoretically under conditions A • of perfect maintenance you are correct in assuming that the present code as now written gives permission to classify this area as a Division 2 location. However, from a practical point of view, I believe you will agree after visiting various pump houses at bulk plants that so-called perfect maintenance seldom, if ever, exists and that it is most impractical to consider that it might. Furthermore, the fact that an explosive atmosphere does not exist at any given time as determined by an explosion recording meter, means little because you will find that very seldom do explosive atmospheres exist even where open flammable liquids are emploved for more than a very small fraction of time. Actually no one individual can rule as to the intent of the Code. However, I believe that Division 2 locations are only those areas adjacent to Division I locations or areas where ventilation of a positive nature electrically interlocked in conformance with the requirements of local authorities is available or areas through which rigid piping extends or where sealed enclosures for the storage of flammable liquids are contained. I therefore feel that the inspection authority in your case was correct in refusing to accept oil immersed starting equipment as Section 5016 of the Code definitely states that in Class I, Division 1 locations, switches, circuit breakers, motor controllers, etc. shall be provided with enclosures approved as a complete assembly for use in Class I locations.-G.R.

#### **Gasoline Pump Switches**

Article 510, Section 5142-d requires that all circuits supplydispensing pumps shall be ina controlled by a switch having a disconnecting pole in each conductor. Does this mean one switch to control all circuits or a switch in each circuit if there is more than one circuit, as is the case, when each pump is put on a separate circuit? I assume this to mean, break the neutral on the grounded neutral system. Now my auestion about a disconnecting pole for each conductor is this. In Article 500, Hazardous Locations, there is no mention made of breaking both sides of the line on single phase grounded neutral system of a disconnecting pole, in each conductor, supplying motors on pumps. Some of the liquids, such as Benzine and others which give off vapors of explosive nature, are as hazardous as aasoline: vet for Class 1. Group D and C. or any group, there is no mention of any restriction, as in Section 5142, Should not the same conditions and restrictions be imposed for all circuits to pumps, lights, etc., for Class 1. Division 5 locations, as is imposed in Section 5142 for gasoline dispensing pumps?-L.J.G.

A. In reply to your first question, Section 5142-d first appeared in the 1946 Code. At that time, the report of the Article 510 Committee of the Electrical Committee made the following comment: "Paragraph d of Section 5142 requires the switch to interrupt each conductor feeding a circuit to a gasoline dispensing pump." I believe this comment further clarifies the intent that each circuit must have its own disconnecting means.

In answer to your second question, which appears to raise an issue worthy of consideration by the Electrical Committee, I can only express an opinion based on information on hand. This rule. Section 5142-d was sponsored by the International Association of Electrical Inspectors, who, from field experience with gasoline pumps,

found the additional safety obtained by switching both conductors was warranted. It appears that no consideration was given this matter by Article 500 since field experience with single phase motors in hazardous locations had not been presented in support of such a requirement. It also follows that gasoline pumps are either moved, serviced or replaced frequently and in view of the large number involved which are supplied through a grounded conductor, any weak spot would be more evident than on motors so used in industry. I also believe, in industry, where large services are common, many similar motor applications are operated without the use of grounded conductors. It therefore appears that the double pole switch required by Section 5142-d is not required in Article 500 due principally to the lack of unfavorable field experience which might warrant such a provision,-B.A.McD.

#### Grounding

May the grounding conductor of an interior wiring system be connected to the neutral service conductor at the service head, the latter not being readily accessible; or should it be connected to the main disconnect switch or meter lng? See Section 2552 and 2611.—G.K.

A Section 2552 states that "the grounding conductor may be connected to the grounded circuit conductor at any convenient point on the premises on the supply side of the service disconnecting means".

Section 2611 states substantially the same requirements as far as the point of connection of the grounding conductor to the interior metal raceways, etc., are concerned.

The code does not require this connection to be readily accessible, it states it shall be "at any convenient point", or "as near as practicable" to the source of supply. The connection as outlined above, therefore, would be permissible.—B.Z.S.

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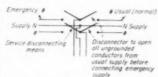
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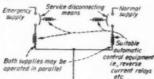
#### Emergency Service Disconnect

Article 230, Section 2351e. Is the disconnector referred to in this section, an automatically or manually operated device? Explain more fully, the intent of this section.—E.J.C.

A This section provides two general types of installations. The first is illustrated in the following diagram:



The second arrangement is shown by the following sketch:



From a study of the two schemes it will be noted that neither illustration shows in detail just what is intended to be accomplished by either connection. Actually the intent is to prevent a "feedback" in to the normal supply source.

This section, therefore, is not definite in its requirement for either a manually or an automatically operated disconnector. From the wording of this section it may be deduced that either type may be installed.

It is possible that there is some confusion in the questioner's mind with regard to the intended application of this section. The fact that he wants to know whether or not a manually or an automatically operated disconnector is required, leads me to wonder if he is not applying this section solely with the idea of providing emergency service for lighting.

The basic intent is to provide emergency service, for example, to an industrial plant being served normally from a private utility but having its own emergency generator. Service from the emergency plant, except as noted in the following paragraph, will be required if

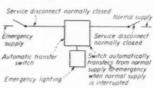
1. the utility lines are dropped suddenly because of same accidental out-

the utility gives notice that its service will be interrupted for some maintenance, operation or construction procedure.

In either case the plant is shut down or must be shut down, respectively, and the switching made to the emergency supply. Then the load is built up to the capacity required within the capabilities of the emergency supply.

Quite often the emergency supply is operated in parallel with the normal supply to take care of loads beyond the capacity of the normal supply. Under these conditions the automatic control equipment must be installed to insure against "Feedback" from the emergency supply to the normal supply and vice versa. In other words, the control equipment must keep the two systems operating in parallel to feed its common load.

For emergency lighting more details are given for these lighting installations in Article 700. An automatic transfer device is usually required. Ordinarily service disconnects may be installed feeding into this transfer switch which automatically prevents "feedbacks" into either system. Schematically this is shown by the following

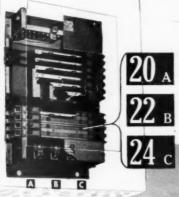


From the above discussion it will be noted that as far as the service disconnect is concerned, either a manually or an automatically operated type of disconnector may be installed.—B.Z.S

#### Panelboards In Clothes Closets

I recently came in contact with a job in a large residence that required two large circuit panels located in clothes closets. This I think is bad but I have been unable to find anything in the Code that would prohibit this practice.—C.W.K.

Section 4115 of the Code rec-A. ognizes the hazard which exists when a fixture is installed in a clothes closet and limits such installations to the ceiling or on the wall above the door, thus reducing the possibility of fire from readily ignitible clothes coming in contact with hot lamps. Section 3853, Article 384 of the Code calls attention to the possible hazard resulting when switchboards are located in the vicinity of easily ignitible material. This same Article also covers panelboards but no such ruling is evident, which indicates the difference in hazard between a switchboard and a panelboard with respect to combustible material. Ref-



Circuit breaker panelboards, of course, but ...

## estinghouse IEIIai se identific saves installation and maintenance time

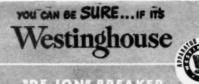
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erence to the definitions of these devices clarifies this distinction.

As you conclude, I also am unable to find any definite Code provision which would prohibit the installation of a panelboard in a clothes closet. However, since a fuse or a circuit breaker is a part of a panelboard, Sections 2435 and 2436 also apply. Reference to these Sections shows that overcurrent devices shall not be located in the vicinity of easily ignitible material and they shall be enclosed unless mounted on panelboards located in rooms or enclosures free from easily ignitible material. I believe these rules may be interpreted to imply that panelboards should not be installed in clothes closets. From field experience, I find most clothes closets to be poorly ventilated areas, filled with readily ignitible materials. A panelboard in such a location with the panel door open, covered with clothes, is a distinct fire hazard when in normal use and especially when being serviced. I believe such an installation violates the fundamental expressed under "Wiring Layout" in the "Introduction" of the Code, which reads: "Provision should be made for distribution centers located in easily accessible places for convenience and safety operations".-B.A.McD.

**Grounding Conductor** 

In wiving residential property where the garage is a separate building, does the Code require that a third conductor or grounding conductor be run from the house to the garage if Type USE cable is buried directly in the earth between the two buildings or is this just a requirement of the local inspection department?—F.G.

If the garage on the back of a residential lot contained no conductive boxes, cabinets, electrical raceways, switch or outlet plates, it would not be necessary that the special grounding conductor be employed. However, should any conductive electrical enclosure of any type be within reach of the floor surface or any other grounding medium within the garage, the Code would require the use of a special grounding conductor run from the service equipment or distribution panel along with the circuit conductors supplying the garage to provide a grounding continuity for all exposed conductive enclosures. If the garage is supplied through a conduit system or electric metallic tubing, it is, of course, assumed that that metallic raceway forms the conductive grounding medium, but wherever open overhead wire or buried USE type of underground conductors are employed, Section 2524 also gives permission to provide a separate grounding electrode at such an outbuilding. However, in urban residential property this is not considered advisable when the neutral ground within the principal building is attached to an underground water distribution system as the resistance at such a ground is invariably considerably less than it would be at a driven ground at the garage and therefore unless a cold water pipe were also available in the garage property, it would be far better to carry the extra grounding conductor from the house to the garage.-G.R.

### Common Neutral— "T" Switches

In the July issue of this Magazine, on the above subject, we answered a Code question which concerned the use of a neutral conductor common to two three phase, four wire, branch circuits as shown by a diagram. In so far as the diagram is concerned, the answer was correct but the general statement reading as follows should not have been made:

"The use of a common neutral for multi-wire branch circuits is no longer recognized by the Code for interior wiring."

The statement should have read:

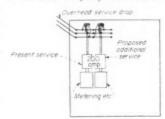
"The use of a common neutral for more than one multi-wire branch circuit is no longer recognized by the Code for interior wiring."

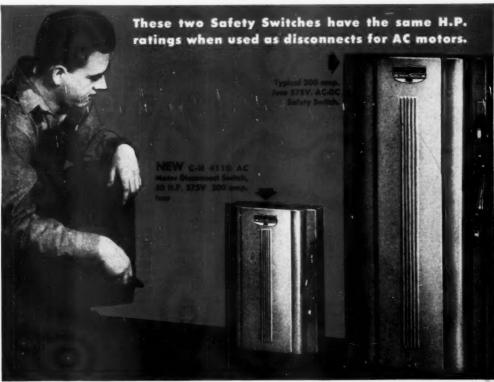
A single multi wire branch circuit may have a common neutral, according to Section 2111 of the Code.

-B.A.McD.

#### Service Entrance Conductors

Po In the sketch shown, can the second 200 ampere, 3 φ switch be placed beside the present one and another set of service entrance conductors run to the outside and connected to the same drop? Both switches would be metered separately. It would be the same occupancy. It would be





### Revolutionary New AC Motor-Circuit Safety Switches

#### matching motor control cases, size for size; matching performance, too

Up until now safety switches have invariably been much larger than the motor control with which they have been used. This has created difficult installation problems. Even when space was available, their bulk and weight made mounting difficult; and the much larger size of the safety switch in such close relation to an associated control enclosure has simply been all out of proportion to the latter. This detracted from the appearance of the complete installation. Cutler-Hammer engineering has ended all this as far as AC motors are concerned. The new and exclusively Cutler-Hammer Bulletin 4110 line of Horsepower Rated AC Motor-Circuit Safety Switches matches safety switch and motor control in size, convenience, and dependability. Available now in ratings from 3 H.P. to 30 H.P., 3 or 4 poles, for 230 Volts AC . . . and in ratings from 7½ H.P. to

50 H.P., 3 or 4 poles, for 575 Volts AC. Inspect these better switches now and see their many features. Front side operated. Quick make and break. Simple release cover-interlock. Provision for 3 padlocks in "OFF" and 1 padlock in "ON" positions. Unit pole construction. Non-welding but type totally enclosed silver contacts. Silver plated current carrying parts. Positive-pressure type fuse clips. Solderless connectors. NEMA 1 enclosure. Complete switch assembly on panel removable for easy installation and wiring. Adequate and convenient knockouts. Cutler-Hammer quality and advanced engineering at no extra cost. These switches have no substitutes even remotely comparable. Your Cutler-Hammer Authorized Distributor can supply you. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

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two 3  $\phi$  services in the same building grouped together for the same occupant.—B.R.

A Section 2301c covers this question. Since both switches are metered separately, it must be assumed that each installation is being made for a different class of use. Under these conditions it would be permissible to install the second service as shown by the diagrant.—B.Z.S.

### Grounding With No. 14 Wire

I want to ground some equipment and find from Section 2595 that No. 14 is large enough. Section 2592 indicates that any grounding conductor smaller than No. 6 shall be in conduit, tubing, or cable armor. This latter requirement has me puzzled since non-metallic sheathed cable has ground wires smaller than No. 6.—C.P.S.

The question you have raised concerning Section which requires grounding conductors smaller than No. 6 to be protected by conduit, tubing or armor was also discussed at the 1951 meeting of the Northwestern section of the IAEI. As a result, this question has been presented to the Electrical Committee of the National Fire Protection Association for a Code revision in line with common practice which usually does not fully satisfy the present Code requirements. In reply to your question, the Code now requires you to protect a No. 14 wire, used for grounding with tubing, conduit or armor and to my knowledge no other method is recognized. As indicated above, however, many Inspectors have permitted No. 14 wire when protected from mechanical injury by enclosure within walls or otherwise with the contention that Section 2592 applies only to system grounds and not to equipment grounds. In view of these conflicting opinions, this matter will undoubtedly be clarified in the Code in the near future. In the meantime consult your inspector concerning this controversial point.-B.A.McD.

### Official N.E.C. Interpretations INTERIM AMENDMENT NO. 96

(Adopted June 9, 1952)

ARTICLE 210.—Branch Circuits, Section, 2113 Voltage. Change to read:

Branch circuits supplying lampholders, fixtures, or receptacles of the

standard 15-ampere or less rating shall not exceed 150 volts to ground, except (1) in industrial establishments the voltage may exceed 150 volts to ground, but shall not exceed 300 volts to ground for branch circuits supplying lighting fixtures only that are equipped either with mogulbase screw-shell lampholders or with lampholders of other types approved for the application, mounted not less than 8 feet from the floor, which do not have switch control as an integral part of the fixture; (1-a) in industrial establishmerts, office buildings, large schools and stores, the voltage of branch circuits which supply only the ballasts for electric discharge lamps in permanently installed fixtures mounted not less than eight feet from the floor, which do not have manual switch control as an integral part of the fixture, may exceed 150 volts to ground, but shall not exceed 300 volts to ground; (2) in railway properties as described in section 1111; (3) for infra-red industrial heating appliances as described in section 4237. In dwelling occupancies, the voltage between conductors supplying lampholders of the screwshell type, receptacles, or appliques, shall not exceed 150 volts, except that the voltage between conductors supplying only, (1) permanently connected appliances, or (2) portable appliances of more than 1,380 watts, or (3) portable motor-operated appliances of 1 horsepower or greater rating may exceed 150 volts.

#### INTERIM AMENDMENT NO. 97

(Adopted June 9, 1952)

CHAPTER 9—Construction Specifications, Secton 92403. Change to read:

Marking. Fuses shall be plainly marked with the ampere and voltage ratings, and the name or trade mark of the maker. The ampere rating and the voltage for which the fuse is designed shall be in bold type. The markings shall be either by direct printing on the fuse barrel or by means of an attached label.

#### **INTERPRETATION NO. 383**

(Issued June 4, 1952)

SECTION 2405—Overcurrent Protection Multi-Phase Systems

Question No. 1: Is it the intent of Secton 2405 that the following type of device be accepted as the overcurrent protection on a 3-phase, 4-wire system: A Circuit breaker assembly having three poles operated by a single common handle mechanism but with an individual automatic overload tripping mechanism for each pole, which automatic mechanism operates only the pole or poles carrying the overload current?

Answer: No, such circuit breakers may be used only for lighting or appliance branch circuits supplied by 3-phase, 4-wire, systems.

# on this page is designed for ONE kind of job...

... the job that a "particular" kind of distribution circuit in your customer's plant calls for.

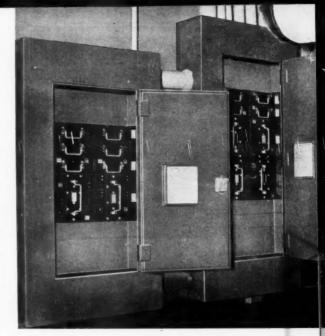
Of course, we both know that the distribution circuits in one plant may be very similar to those in another, but, when you come right down to it, you won't find very many electrical distribution circuits that are exactly the same.

To make sure your customer gets the best panel for each application, Trumbull does two things:

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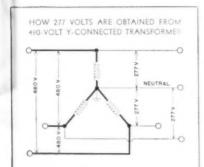
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The same fluorescent lamps and fixtures used with 120-volt installations are used with higher voltages. Only the ballast need be changed—and the higher voltage ballasts are a standard item.

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Higher voltage at the wall switch is eliminated with the G-E remotecontrol wiring system. The remote-control switch requires only 24 volts. The switch actuates a relay which is located in or near the knockout box at the fixture. The relay does the actual ON-OFF switching of the higher voltage.

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You can also have more than one switch to turn on and off any important group of lights. And selective lighting, with a master selector switch, is now economical for example, long-needed selective lighting for the night cleaning force or for a watchman's rounds.

For savings, safety, and convenience, investigate the 277-volt lighting system and G-E remote control. Write today for a copy of G-E Remote-Control Manual of Layout and Installation. Section D53-818, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.



MASTER SELECTOR SWITCH permits flexible control of large areas of lighting from central locations—can be used for watchmen's circuits and standard lighting control.



ADDED COPPER SAVINGS are accomplished by this small, lightweight control wire used with the G-E remote-control wiring system. Wires can be laid up on partitions, can be rerouted easily at any time.



REMOTE-CONTROL RELAY operates on 24 volts—cuts costs and copper required to run load lines down to switches. Rated ½ hp, 15 amp, 125 volts; 10 amp, 277 volts. No need for derating with fluorescent loads.

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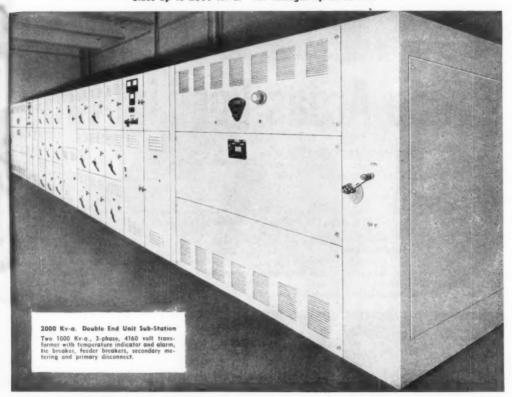
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### **Motor Shops**



ARMATURES are held in place while being tested or worked on in the shops of Albertson & Son, Philadelphia, Pa., by a simple adjustable holder made for this purpose.

#### Armature Holder Simplifies Testing

A simple adjustment holder has been devised by Albertson & Son, Philadelphia, for holding armatures while being tested, worked on, etc. This firm has made a number of these holders and they are constantly in use.

The holder consists of a wooden base, about 12 inches long and four inches wide, made of 1½" wood. Two metal pieces have been attached to the base, about two inches high.

Two round steel bars, §" diameter have been placed through the metal sides to act as holders.

Two metal slides, each with two holes through them, have been slid onto the rods and they can be moved back and forth freely. These slides have "V" cuts in them, so that the shaft can be held in place while the armature is rotated if necessary.

#### Motor Operates Two Winders

Two winding heads have been attached to a single motor. This eliminated having two winding machines in the motor repair shop of Jarvis-Electric, Camden, N. J.

"By putting two heads on one motor, we have eliminated one machine entirely which has saved space and given our shop employees one machine with which to work on, for winding concentric coils on one side and polyphase diamond or square coils on the other," says Fred W. Jarvis, owner.



**TWO WINDING HEADS** on one motor enabled Jarvis Electric, Camden, to climinate one winding machine, save shop space. Fred Jarvis is using right-hand head, other is in foreground.



POOT BRAKE BAR switches power from one winding head to the other in an inganious arrangement whereby one motor serves two separate heads. Device was made by Fred W. Jarvis, owner, Jarvis Electric, Camben, N. J.

"Thus our winding employees can use either head on this machine."

The two heads are mounted on a single \( \frac{1}{2} \) hp motor that is mounted in the housing. The shafts on which the winding heads are mounted are driven by pulleys from the motor. Both heads turn simultaneously, when in operation,

A clutch type brake is operated by a movable foot brake bar. When either head is being used, the employee just pushes the brake har over to the side that he is working on.

This double head winding machine was constructed in several hours by Fred Jarvis.

#### Hoist and Pliers Rip Stator Coils

A clever arrangement of a pair of vise-grip pliers and an overhead chain hoist has greatly reduced the time and labor required for ripping out stator coils at the Electric Motor Service Co., Chester, Pa. George Malony, the shop superintendent, developed this method of removing stubborn, burned-out stator coils.

The basic equipment required for this time-saving operation consists of a pair of vise-grip pliers, an overhead chain hoist and a work table with a set of screw clamps for securing the stator frame during the operation. A small tongue is welded onto one side of the gripping mouth of the pliers, and a hooking loop is welded onto the handles end.

When stator coils have to be ripped out, the stator is placed on the work table and the screw clamps positioned to hold the stator frame securely in place. The vise-grip pliers are then hooked on a section of the coil to be ripped out, and the hooking loop on the handles end of the pliers is placed



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THE STANDARD TRANSFORMER COMPANY WARREN, OHIO . OFFICES IN PRINCIPAL CITIES





VISE-GRIP PLIERS are hooked to an overhead chain hoist which greatly facilitates ripping-out stubborn coils from the stator frame which is firmly held by screw clamps on the work table.

on the chain hoist hook. By pulling on the chain hoist, the pliers quickly and easily rip out a large part of the stator coil. This procedure is repeated on other sections of the coil, mtil the entire coil has been removed.

With this coil ripping set up, what was formerly a long and tedious task is now just a matter of minutes.

#### Pneumatic Coil Puller

A coil pulling device constructed by Milton H. Eisenhardt, Camden, N. J., motor repair shop, only takes a few seconds to remove burned out coils where it consumed a half hour or more by the usual hand removal operation.



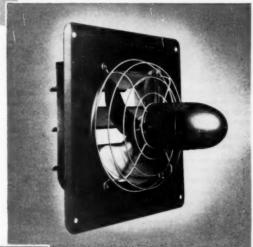
COIL PULLER used in Militon H. Eisenhardt Motor Repair Shop, Camden, N. J., uses pneumatic pump to actuate claw, shown coming up to grip coils in stator resting on metal collar used to prevent domage during pull.

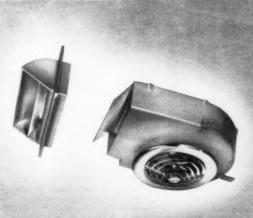
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- Wide, deep-pitched 4-petal blade assemblies on all but 16" model, which has a 6-petal blade assembly.
- Gravity-type hooded shutters with replaceable aluminum vanes which operate in unison.
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- · Attractively finished in durable hammered gray enamel.





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ELECTRIC MFG. COMPANY, MENOMINEE, MICHIGAN



# COIL WINDING

#### TAKES A

### **HEAD!**

For efficient, accurate coil production, the GC HEAD pictured above is without parallel in the electrical industry. Its construction embodies a cam collapse mechanism for all winding fingers which allows quick removal of coil groups and instantaneous repositioning for further winding.

Winding fingers are set to coil dimensions by screw adjustment and a complete setup can be made in less than two minutes.

Attachments are available for loop winding and single phase winding. Swivel End Finger attachment forms knuckles in the nose of the coils which removes strains, makes winding easier and reduces possibility of short circuits.

Can you be satisfied with less than the best?

 Write for descriptive literature on the GC HEAD and other winding equipment of our manufacture.



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Illustration shows Model 301 straight "ON and OFF" Time Switch for use where two or four operations per day are required. Self-starting, heavy-duty motor available in 115 or 230 volt, SPST, SPDT and DPST models.

SEE YOUR JOBBER OR WRITE FOR INFORMATION AND CATALOG

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WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF TIME CONTROLS FOR ALL USES



**CLAW GRIPS COILS** and exerts up to 500-lb. pulling pressure, enabling coils to be pulled quickly and without damage to stator.

A claw grabs the coils to be removed and makes a sharp pull that rips them out of the stator. It can remove several coils by this repeat action within a matter of seconds, by applying the claw to each group of coils that have to be ripped out each time. This device has saved many man hours in the shop.

The coil pulling device consists of a 4 in. x 8 in. long pneumatic pump that has a 100 lb. pressure but an actual 500 lb. power when in operation. This pump is attached to a circular steel base, one inch thick and 10 in. in diameter, and this base is attached to a worktable.

There are three \(^4\) in, circular steel rods, 12 inches long attached to the base in an upright position, at three points to form a "V" shape. A semi-circular piece of steel has been welded onto the top of the rods to form a seat.

"A reverse action valve forces the shaft in the pneumatic pump to go up or be drawn down," says Milt Eisenhardt. "To the top of this shaft, we welded a claw type of arm. This claw grips the coil and the reverse action of the pump snaps it down. As the stator is kept in place on the seat, the coils are ripped out."

In order to prevent damage to the stator, such as pulling it off center or damaging the lamination, steel supports have been made. These are cut in the shape and size to hold the stator in a balanced position while the coils are being ripped out. The stator is in an upright position while the coils are ripped out, and the supports or the heads hold the stator evenly to prevent any damage to it. The operation combines speed, ease and safety.



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ROLLING TABLE is a time and labor saver for loading the bake oven at the Electric Motor Service Co., is rolled along tracks into and out of the oven

#### Rolling Table Loads Bake Oven

A simplified method of placing armatures, stators, etc., into the bake oven has effected an appreciable saving in time and labor at the Electric Motor Service Co., Chester, Pa. The method utilizes a rolling table which can be moved in and out of the bake oven.

The complete constructional work which was necessary for the set up was done right in the shop. A set of tracks were laid in the floor of the shop to run from several feet outside the bake oven to the interior of the oven. Then a steel work table was constructed with casters on its base. The position of the casters on the table accommodates the distance between tracks to allow free and easy movement of the table along the tracks. Although the doors of the oven must close right over the tracks, the doors are well fitted so that no heat is lost when the oven is in opera-

When armatures, housings, etc., have to be baked, they are placed on the table with the use of an overhead hoist. The table is then easily pushed along the tracks to the interior of the bake oven; the doors are closed; and the baking started. When baking is completed, the table is withdrawn from the oven.

The men in the shop have found this method of distinct advantage. In addition to saving time and making the work lighter, the men no longer have to enter or work in the hot oven to load or unload the equipment. In addition to increasing the efficiency of the loading operation, this method has also reduced the hazard of injury to personnel and equipment.

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Patents Pending

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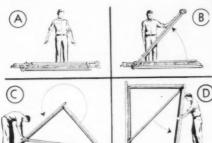
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## In The News

#### N. Y. State Electrical Contractors Met at Saranac Inn, New York

The 53d annual convention of the New York State Association of Electrical Contractors and Dealers, Inc., was held at Saranac Inn, Saranac Inn, New York, from July 1 to 4. More than 350 attended, representing all branches of the industry.

A. Lincoln Bush of New York City, chairman Emeritus of the Board of Directors of the Association, was general chairman and presided at the opening session. The theme of the convention, "The Readjustment Period", was announced by President R. J. Knoblock of Syracuse, in his opening address.

S. J. Cristiano, field director, Eastern Region of the National Electrical Contractors Association, spoke on the "Contractors Place in the Electrical Industry". The contractor is a business man who provides two very essential services to the public-the services of a specialist in electrical installations of all types and a center for information to which the public may turn whenever it has a question, he said. The electrical contractor is the key man in the expansion of electrical use in the ever-increasing consumption of electrical energy. It is our obligation, he continued, to promote the value of the specialty electrical contractor directly to the customer; second, to promote the services of the electrical contractor to the constructor type of contractor; and third, to promote the sale of the smaller contractor's services to the home owner and the general public.

'Are There Too Many Electrical Contractors" was the title of the talk given by Arthur R. Hines, commercial vice president, General Electric Co. He stated that there is a \$2 billion backlog in the home wiring modernization field. This does not include at least \$100 million of additional business which is being lost to the electrical contracting industry each year from the new home construction field. Of the 1,092,500 dwelling units started during 1951, it is safe to estimate that at least one million were not adequately wired, according to electrical industry standards of adequacy. Unless something is done to get these millions of homes wired adequatelyand soon-the potential market for

new appliances will be throttled.

There are 32,000 electrical contractors in the U. S., Mr. Hines continued. An extra \$62,000 per year is available to each contractor in residential rewiring. Sales and advertising materials, campaign plans, national advertising in consumer magazines create public demand for adequate wiring. Electrical contractors must actively cooperate with the rest of the electrical industry in the effort to break loose the many millions of dollars worth of additional wiring that is waiting in the residential field.

Martin R. Gainsbrugh, chief economist of the National Industrial Conference Board, presented "The Economic Outlook". The concluding speaker was D. B. Clayton, president of NECA. He spoke of the problems of the electrical contracting industry nationally, and the importance of associations in helping to work out the solution.

William A. Lyons, vice president, New York Electric & Gas Corporation, Binghamton, was chairman of the Wednesday session. The first speaker, F. C. Shaughnessy, manager, Outside Plant Construction, Consolidated Edison Company, New York, spoke on the "Mechanization of Transmission and Distribution Construction Methods". Motion pictures were shown of the digging and pipe laying machines developed for his company.

Harold I. Howell, system project engineer, Niagara Mohawk Power Corp., Buffalo, outlined the history of the Niagara hydro-electric power plant development. Industry's role in atomic energy was presented by Donald C. Moore, director, Division of Engineering and Construction of the New York operations office, United States Atomic Energy Commission.

The chairman of the Thursday session was C. S. Purnell, eastern electric utility manager, Westinghouse Electric Corp., New York. Speakers that day were W. H. Robinson, Jr., Advertising Department, Lamp Division, General Electric Co., who spoke on the subject of "Crisis in Confidence"; L. R. Anderson, Lamp Division, General Electric Co., who discussed "Profits in Lighting for the Contractor"; D. C. Hooper, manager Market Planning, Westinghouse Electric Corp., presented "The Future of the Electrical Industry"; and E. W. Beggs, Lamp Division, Westinghouse Electric Corp., described the new fluorescent mercury lamp developed by his company.

At the last session on Friday morning, A. Lincoln Bush presided. E. G. May of Albany, chairman of the Board



SPEAKERS at the NYSECD convention at Saranac Inn were D. B. Clayton, President of NECA, A. Lincoln Bush, New York City and M. R. Gainsbrugh, NICB, New York.



NASSAU-SUFFOLK ELECTRICAL League members attending recent convention of New York State Electrical Contractors and Dealers at Saranac Inn, N. Y. From left to right (seated)—George Scheider, Fred Mattfield, William Aldrich, William Berken, Jos. Hagendorn; (standing) Frank Curley, Henry Froeder, J. J. Frohnhoefer, C. R. Banes, Joseph Lorenz, A. L. Herbert, and H. W. Morrison.

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H. F. JANICK, Rochester, D. J. Crimmins and A. A. A. Tuna, both from New York City, at the NYSECD convention.

of Directors, discussed the need for reinspection of electrical installations for the protection of life and property from electrical fire hazards. Regular inspection of residential and commercial properties by the New York Board of Fire Underwriters and municipal inspectors was recommended to the membership.

Uniform codes and standards by utility companies throughout the State were requested by the membership for the installation of light and power services and metering facilities.

A resolution submitted by R. J. Mitchell of Buffalo supporting the hydro-electric development of the Niagara River by private enterprise was adopted.

The following officers for the ensuing year were re-elected: R. J. Knoblock, Syracuse, president; W. C. Drexler, New York, 1st vice president; H. F. Janick, Rochester, 2nd vice president; and J. F. Burns, Schenectady, treasurer, H. A. Webster, New York; E. G. May, Albany; Walter Langdon, Utica; Louis Freund, New York; and A. Lincoln Bush, New York, were re-elected directors.



R. W. MITCHELL, Buffalo, James F. Burns, Schenectady, and J. M. Smith, Cohoes, during the meeting of the New York State Association of Electrical Contractors and Dealers at Saranac Inn. N. Y.



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ACTIVE PARTICIPANT in forum session at recent NISA Convention in Chicago was R. B. Turner, Johnson-Turner Electric Co., Windsor, Ontario, Canada.

#### Chicago Wins Regional **Lighting Contest Award**

A jury of five national officers of the Illuminating Engineering Society selected the "My Most Interesting Lighting Job" entry of C. H. Johnson, Chicago, to represent the Midwest Region at the IES National Technical Conference to be held at Chicago's Edgewater Beach Hotel in September. Judging was held during the meeting of the IES National Council at Swampscott, Mass. Judges were: R. G. Slaver, vice president, Northeast Region; L. B. Paist, vice president elect, Midwest Region; Walter Sturrock, past president, IES; C. L. Crouch, technical director, IES: and Paul Hildebrand, vice president, East Central Region. C. N. Laupp, vice president, Midwest Region acted as Captain of Judges.

Mr. Johnson, a partner of Johnson and Johnson, architects and engineers, qualified for the Regional Contest by winning the local competition cosponsored by the Chicago Section, IES and the Chicago Lighting Institute at a final judging in May. Judges John O. Kraehenbuehl, University of Illinois Electrical Engineering Dept.; John S. Van Bergen, Barrington, Ill., Architect; and Charles N. Laupp, IES Midwest Regional vice president, Milwaukee, selected Johnson's entry as best of five "classification" winners of a preliminary judging of 22 entries.

Other "classification" winners of the Chicago contest were: J. Stewart Stein, Architect (store); Albert Kurtzon, Alko Mig. Co. (miscellaneous); George Gilleard, Curtis Lighting, Inc. (school); and Warren I. Byers, Jr., Crouse-Hinds Co. (Industrial).

Mr. Johnson's entry in the "office" classification covered the remodeling and relighting of the Banking Floor for the Bill Savings and Loan Association in Chicago and illustrated the design of a lighting system to meet architectural and structural conditions.

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#### **NISA News**

The first N. Y. Committee meeting for the N1SA '53 Convention Arrangements was held at the Statler Hotel, June 28, under the able and energetic chairmanship of Hillrie Griffith.

The various committee chairman selected were: General Chairman, H. Q. Griffith; General Committee, W. J. Wheeler, A. Bonahur, S. Bojack, and L. D. Kennedy; Program Co-Chairmen, H. W. Engleman and Sam Heller; Reception Committee, Stan Bojack; Publicity Committee, Walter Prise; Registration, Al Bonahur; Ushers, M. Friedkin; Exhibits, Al Shovan; Ladies Committee, Mrs. W. J. Wheeler and Mrs. A. Bonahur.

The second quarterly meeting of the Mid-South Chapter of NISA was held at Hill Top Lodge, near Southport, Alabama, on June 7, with 29 members and guests present.

This meeting was arranged by President Howard and Vice-President Russell. It was planned to be a week-end outing strictly for pleasure.

Saturday evening President Howard called a brief business session in order to officially set the next quarterly meeting date and place, and to accept new members. The new members were: Mr. Louis Cottrell, Louis Cottrell Electric Co., Sheffield, Alabama, approved as a regular member. Frank D. Spiegel, Brownell Distributors of Atlanta, Inc., Atlanta, Georgia, was accepted as an Associate Member. Sam Browning extended an invitation to hold the next regular meeting in Bir-



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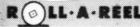
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mingham, Alabama on September 13, Motion that the invitation be accepted was duly adopted. No further business being at hand the meeting was adjourned by President Howard.

The regular meeting of the New England Chapter was held at Hotel Bradford on June 12. The meeting was called to order by the president, Harry Bedig, and 53 members were present. The president conducted a buy and sell session and there was a short discussion on the program for next September. The president then called on Program Chairman E. Kolhonen, who introduced Mr. Hirshberg, Mr. White and Mr. Morse of the Spencer Thermostat Co. of Attleboro. Mass. Ed Kolhonen then called on Mr. Hirshberg who gave a complete, informative talk on the use of Klixon Protectors for motors. This talk was accompanied by the showing of films. At the conclusion of his talk there were many questions from the members and this discussion was continued after adiournment.

William J. Engel, T. B. MacCabe Co., was named president of the Quaker City Chapter at the May 14 meeting. The Philadelphia group also chose Samuel Augustine, Electric Motor Specialty Repair Co., Reading, Pa., vice-president, and Wm. M. Hendrickson, Wm. M. Hendrickson & Co., Philadelphia, Treasurer. Frank A. Schaef, Electrical Maintenance Equipment Co., Philadelphia, was retained as secretary.

Officers of the Ontario Chapter have been elected for the coming year. The group chose C. J. Ainsworth, Ainsworth Electric Co., Ltd., Toronto, as president: A. G. Bamford, Sutherland & Schultz Electric Co., Ltd., Kit-

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#### **New Advertisements**

received by August 21st appear in September issue, subject to space limitations.

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chener, secretary; and Ross T. Sawle, Blenkhorn & Sawle, Ltd., St. Catherine, Treasurer, .

New officers of the Great Lakes Chapter are Bruce Palmer, Palmer Electric Co., president; Walter Cohen, J-C Electric Co., vice-president: Charles Howard, Howard Electric Co., treasurer; J. G. Spaulding, Spaulding Electric Co., secretary, Charles Johnson, University Electric Products Co., associate member, has been retained as executive secretary.

The Central District Chapter held its last meeting until September at the Electric Club in Chicago, June 10. The dinner meeting featred two sound and color films; a Westinghouse Vera Vague-Sterling Holloway comedy and "Lubricating Oil's Amazing Molecules

. . .

New Officers of the Louisville Chapter were recently elected. The group chose N. A. Krauth, Krauth-Campbell Electric Co., president; George Rui, J. George Electric Co., vicepresident: Joseph P. DeVine, Louis Davis Electric Co., secretary: and E. M. Murphy, Marine Electric Co., treasurer.

Walter Prise, Chairman of the publicity committee and M. Friedkin journeyed to Buffalo by plane, Saturday. June 14, and spoke briefly before the Niagara picnic gathering at Schlehr Ranch, Langford (N. Y.), outlining plans for our coming New York City NISA convention.

The NISA Niagara members, their wives and children had a wonderful day of recreation, thanks to the genial host John Schlehr of S. & S. Electric Co, and Glen Frosdick.

From Walter J. Prise, The Maintenance Co., Inc., New York City.

#### Arthur L. Abbott

Arthur L. Abbott of Rutherford, N. J., author of "The National Electrical Code Handbook," died on July 26 after a brief illness. He was 79,

Mr. Abbott, who also wrote "The Electrical Contractors Estimating Manual," is thought to have been the first man to develop standards for electrical estimating, now widely used in the industry.

A native of Albert Lea, Minn., he was a graduate of the University of Minnesota and for many years was an electrical contracting engineer in St. Paul.

Since 1928 he had been technical adviser to the uniform legislation department of the National Electrical Manufacturers Association of New York.

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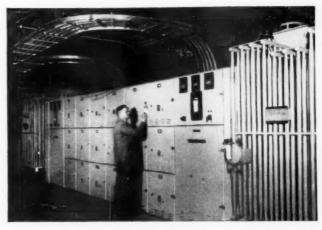


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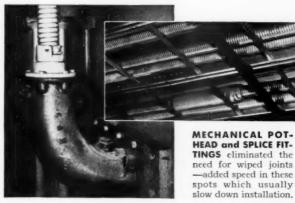
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